

# The Auk

*A Quarterly Journal of Ornithology*

Vol. 72

APRIL, 1955

No. 2



PUBLISHED BY

**The American Ornithologists' Union**

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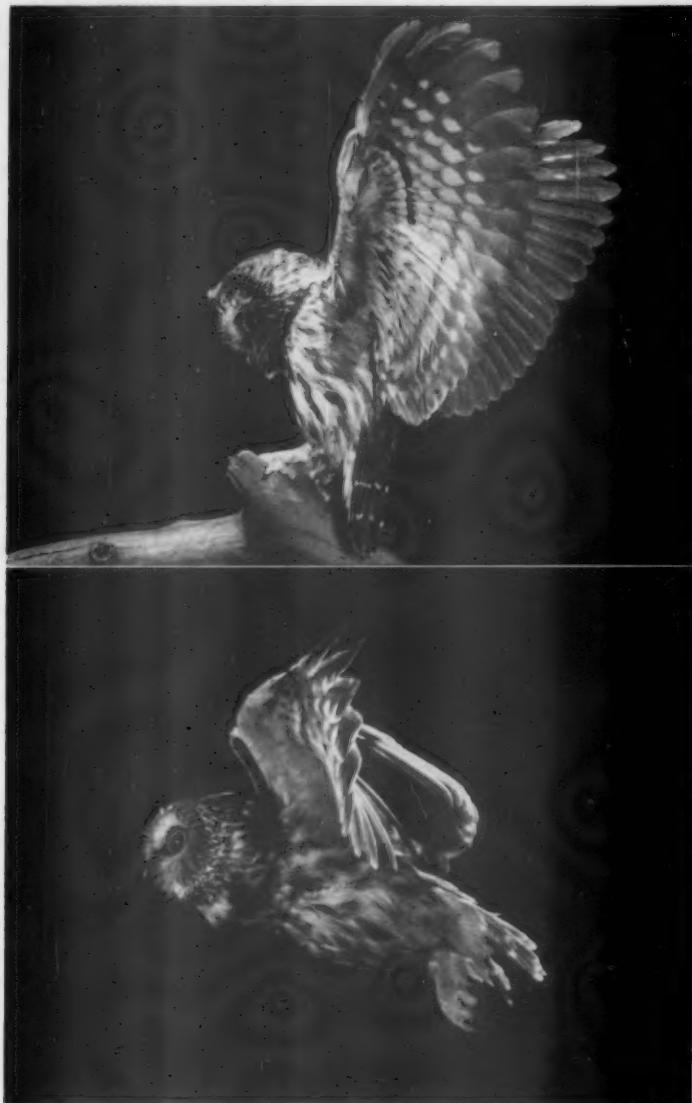
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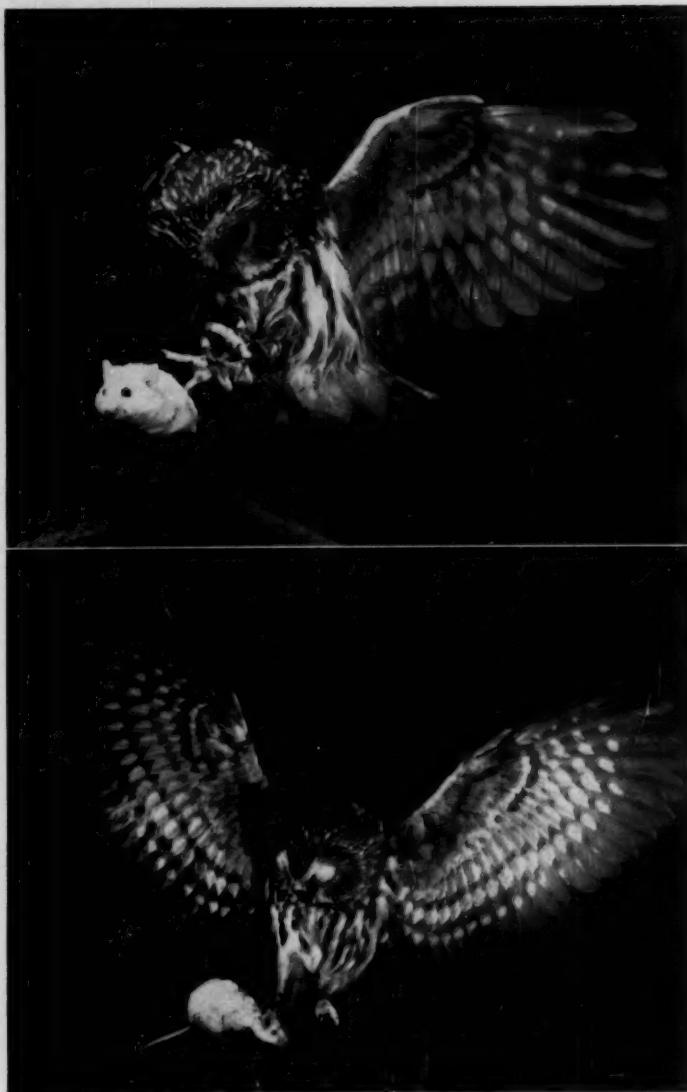
Printed by The Intelligencer Printing Company  
Lancaster, Pa.

Entered as second-class mail matter in the Post Office at Lancaster, Pa.,  
May 15, 1920, under the Act of August 24, 1912

Accepted for mailing at special rate of postage provided for in the Act of October 3, 1917, embodied  
in paragraph (d)—(2) of Section 34.40, P. L. and R., of 1918, authorized May 15, 1920.



SAW-WHET OWL (*Aegolius acadicus*) IN ACTION. (Top) with wings spread, the bird watches, ready to fly down for a mouse. (Bottom) In flight. These pictures and those on the following plate were taken indoors by Robert C. Hermes.



SAW-WHET OWL IN ACTION. (*Top*) Photographed just an instant before it touched a mouse, its talons fully spread and its eyes wide open. (*Bottom*) Immediately after striking a mouse. The impact of the blow has raised the rear of the mouse. The eyes of the bird are closed when it strikes.

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ORNITHOLOGY

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NATURAL HISTORY AND BREEDING BEHAVIOR  
OF THE TINAMOU, *NOTHOPROCTA ORNATA*

BY ANITA K. AND OLIVER P. PEARSON

ON the high mountainous plain of southern Perú west of Lake Titicaca live three species of the little known family Tinamidae. The three species represent three different genera and grade in size from the small, quail-sized *Nothura darwini* found in the farm land and grassy hills about Lake Titicaca between 12,500 and 13,300 feet to the large, pheasant-sized *Tinamotis pentlandi* in the bleak country between 14,000 and 16,000 feet. *Nothoprocta ornata*, the third species in this area and the one to be discussed in the present report, is intermediate in size and generally occurs at intermediate elevations. In Perú we have encountered *Nothoprocta* between 13,000 and 14,300 feet. It often lives in the same grassy areas as *Nothura*; indeed, the two species may be flushed simultaneously from the same spot. This is not true of *Nothoprocta* and the larger tinamou, *Tinamotis*, for although at places they occur within a few hundred yards of each other, *Nothoprocta* is usually found in the bunch grass known locally as *ichu* (mostly *Stipa ichu*) or in a mixture of *ichu* and *tola* shrubs, whereas *Tinamotis* usually occurs in the range of a different bunch grass, *Festuca orthophylla*. The three species of tinamous are distinguished by the inhabitants, some of whom refer to *Nothura* as "codorniz" and to *Nothoprocta* as "perdiz." *Tinamotis* is always called "quivia," "quello," "keu," or some similar derivative of its distinctive call.

The hilly, almost treeless countryside in which *Nothoprocta* lives in southern Perú is used primarily for grazing sheep, alpacas, llamas, and cattle. The shepherds caring for these animals are the most important predators on *Nothoprocta*, for they hunt and eat both the eggs and the birds. Other common predators are the Andean fox (*Dusicyon culpaeus*), a large *Buteo*, and dogs belonging to the natives.

Our observations were made between December, 1951, and June, 1952, and in July, 1946. We dissected 40 specimens of *Nothoprocta ornata* and spent numerous hours searching for and watching live birds in their natural habitat. Many of our observations were made with binoculars at a distance of 100 to 300 feet from the windows of the converted bus in which we lived and travelled. For nest watching, stone blinds were erected about 200 feet from the nests. At other times we successfully watched *Nothoprocta* at distances of more than 200 yards without any attempts to conceal ourselves. This was possible because of the mountainous nature of the area.

We succeeded in marking only one individual, an incubating male that was squirted with dye as it sat on its nest. Another individual was recognizable by a distinctive feather pattern. We became sufficiently acquainted with the call notes of a third bird so that we believed we could identify it by its call alone.

For this report we have also drawn upon the field notes of Carl B. Koford between April, 1951, and June, 1952, and upon his notes on the twelve specimens of *Nothoprocta* dissected by him.

#### GENERAL HABITS

*Nothoprocta ornata* is grouse-like in appearance with very little tail and with erectile feathers on the crown. When a bird of either sex is excited, the feathers may be drawn up into what appears to be a black crest. The crest is seen more frequently on the female. As in some other members of the Tinamidae, the females are slightly larger than the males. Among 10 adult, sexually active specimens of each sex taken between February and April, the females averaged 674 grams (range 593 to 761) and the males 569 grams (444 to 700). The bill also appears to be larger in the female: eight females had an average bill length of 28.2 mm. (26 to 30), while among seven males the bills averaged 25.0 mm. (23 to 27). Other than these size differences, which alone are not reliable field criteria, there is little sexual dimorphism in this species. Among 52 birds collected by shooting, the sex ratio was exactly 1:1.

In a number of cases an observed copulation plus a recognizable size difference in a pair of birds enabled us to keep straight the sex of individuals we were watching. The sex of the unmarked live birds referred to in this report was determined in this way.

*Nothoprocta* climbs onto boulders for sunning, preening, or calling, but it spends most of the time walking, feeding, or preening on the ground. As *Nothoprocta* feeds, the head is usually held down. Every few pecks, however, the bird raises its head, pauses, and looks about.

We have not seen them scratch. Frequently these birds stop behind grass clumps for extensive observation of some disturbance, their thin necks concealed by the dried stems. When *Nothoprocta* is using extreme caution in walking, the head and body are completely rigid, the neck erect, and the feet move so slowly that the motion is hardly seen. This behavior was observed in a male bird escorting his brood of chicks from the nest. At other times, when caution is less extreme but the bird is disturbed, agitation is expressed by a bobbing of the neck back and forth in an anteroposterior plane. This motion appears to be an exaggeration of the neck movements ordinarily accompanying walking and may indicate the bird's uncertainty as to whether to run away or stay. On the other hand, perhaps this motion serves the purpose of "rapid-peering" in increasing the stereoscopic vision of the bird so that it can better assess the disturbance. A bird may bob its neck 20 to 30 times without moving its feet.

*Nothoprocta* may fly when chased by another of the same species, when disturbed by man, livestock or other animals, to cross streams, to reach feeding grounds, or at times for no obvious reason. When flushed by a person, the bird explodes into the air with a loud and startling series of screeches. The wings are flapped in the first rise of the flight and they are then held in an arc as the bird glides around the hill and lands, out of sight if possible, from 50 to more than 200 yards away. When a bird is flushed by another bird or by a grazing animal, the flights are shorter and may or may not be accompanied by screeching. Almost all flights are downhill, but on one occasion a bird flew 40 yards uphill. Frequently the bird runs after it lands.

The distance at which a human may flush *Nothoprocta* varies from 1 to 20 feet. On two occasions we saw an Indian on horseback spot a bird squatting in the grass, ride up to it and circle it twirling his rawhide lariat. The Indian tried to hit the bird with his short lariat before it took off. A male that had been incubating for several days did not flush from the nest when an Indian girl walked within inches of him, when a dog passed by within a yard, when some of a herd of llamas jumped over the grass clump that shielded the nest, and on three occasions when squirted with dye from a distance of six feet.

Although not averse to flight, since they fly when unprovoked, the usual escape technique used by *Nothoprocta* is to dash away as much as 20 yards and squat underneath a clump of grass or tola. We have seen birds run in this manner from man, dogs, and from other birds of the same species. At times the dash is executed with the head held erect, neck stretched upward and rump correspondingly

depressed. If the bird is more closely pressed, the neck is stretched out in front and the head is on a level with the body as the bird streaks through the grass. In general the lowered head is the attitude of a pursued bird. If a bird is the aggressor in a chase with another bird, it may hold its head either up or on the horizontal.

*Nothoprocta* does most of its feeding on the moist green seeps that are scattered throughout its range. These feeding areas are usually low on the hillsides or along the valley floors, and some birds come at least 200 yards down the hills to feed on them, and then return up the hills. They feed on clover and other small leaves, buds, blossoms, fruits, berries, roots, pods, seeds, and sprouting seeds. Several species of beetles and caterpillars as well as grasshoppers and an ant have been found in the crop. Occasionally the birds move dried cow chips, apparently searching for insects.

In addition to the screeching noise given as it rises in flight, or in the course of ground chases between two birds, *Nothoprocta* makes a chirp like the first note of the alarm call of the American Robin. This seems to be at times a location call and at other times a territorial note. The monosyllabic call may be repeated at intervals of from 3 to 20 seconds for as long as three hours, and it can have different qualities depending on the intensity and harshness of the note. A series of calls that begins softly may become raucous and aggressive sounding. Occasionally two birds that are separated call to each other, but the calls are not in unison. The neck is flexed back and down at each note. Another call described as "eee-arr" is given occasionally, but its significance is not known. Two birds collected while calling in this manner were females with ripe ovarian follicles.

On one occasion the common, short call was used by an alarmed bird. In order to improve our visibility we had placed a 4 X 12 inch mirror eight feet from a nest several weeks along in incubation, while the male parent was off the nest. Although he could not see himself in it when he returned, he was concerned about the mirror and with much head-bobbing and calling he alternately approached the nest and retreated for almost two hours, whereupon the mirror was removed. This same bird called while sitting on the eggs.

Both males and females call, although when a male and female are together only the female has been observed to call. The birds call at any time of day, particularly in the early morning and late afternoon. A common call situation from our notes of February 26, 1952, is as follows: "a male appeared near the base of the hill and, while calling, made his way out into . . . [the feeding area]. Perhaps in response to his calls, a female appeared out on the flat and joined

him, whereupon the calling stopped." Follow-feeding (described below) ensued, and, finally, copulation.

A fourth kind of call was heard on one occasion when a male parent and his brood of more than four half-grown young (177 grams) were surprised along a road and separated. The note was a somewhat musical "chuck-chuck, chuck-chuck," and seemed to be a location call of the separated young. Since the adult was collected first, he was not heard to give this call.

#### SOCIAL BEHAVIOR

We have encountered *Nothoprocta* singly, in pairs, and in coveys, but not in the trios that we found common among *Tinamotis*. The coveys seem to be family groups, with an adult still attending when the young are half grown. Coveys were seen in February, April, and May. Five pairs of *Nothoprocta* were collected, and each pair consisted of a male and a female. One pair was taken in August (perhaps juveniles), and the other four pairs were taken from December to February. Five additional specimens taken between February 3 and March 12 were known to be one of a pair at the time of collection.

The tinamou pairs that we have watched in February and March on feeding areas spent much of their time foraging aimlessly in a manner that we have termed follow-feeding. Usually the male precedes as he feeds and the female follows and feeds 3 to 10 feet behind. Both birds stop and preen for short periods. A pair can spend as much as two and one half hours feeding almost continuously in this desultory manner on a half acre of feeding area. Single birds feeding in a more business-like manner can finish in a half-hour.

We have observed many chases between two birds of this species, females chasing females, females chasing males, and males chasing birds of unknown sex. We have not seen a male chasing a known female. An example of a chase observed on March 10, 1952, is as follows: "Watched the pair . . . [that had copulated about 15 minutes earlier] feed for a while, then thought I saw the male display, and the female subsequently started chasing him. Heard a soft, long version of their flying screech as the male, head down, tore through the grass. The female chased him with her head held up. The male would make a short dash, duck under some grass and double back on his tracks, but the female always managed to find him again and continue the chase. The chase lasted about five minutes, when the male took off screeching and landed across the gully." Frequently the pursuing bird continues to run 15 to 20 yards in the same direction after the pursued bird has flown.

The female of *Nothoprocta* is conspicuously more aggressive than the male. When a pair is together only the female calls. Either bird may lead in follow-feeding, although the male is usually in front, but if an aggressive action is involved the female leads. For example, when a pair is approached by another pair of birds or by a single bird, the male remains passive while the female runs through the grass and bill-to-tail, drives off the intruders.

Courtship consists largely of follow-feeding activity. The male while feeding in front of the female may display with either his head or tail toward the female, raising the rump and spreading the short rump feathers. Twittering and squeaking sometimes accompanies this behavior. The raising of the rump exposes the rust colored feathers of the crissum and makes conspicuous a round dark patch on either side of the vent. The patches may result from the feathers parting in a way that reveals their dark basal portions. The common reaction of the female to a display is to dash three to ten feet away, usually running from her position behind the male to a position in front of him and a little to the side of the direction they had been travelling. If the female remains standing at the end of the dash, the follow-feeding continues and the male may display again. But if the female squats at the end of the dash, the male usually runs quickly to her and stands on top of her, facing in the same direction as the female. The primaries of the male are depressed and flicked while he stands on the female, but the wings are not flapped vigorously as in *Nothocercus* (Schäfer, 1954). The female stirs occasionally and the male makes treading motions, perhaps only to maintain his balance. His treading is not vigorous, as it is in chickens, and he does not grasp the female with his bill, but holds his head up. He stands upright, in contrast to the rooster, who squats on the female. The mounting of the tinamous sometimes lasts a full minute, during which there is no cloacal contact. At the end of this time there are some rapid movements during which the rump of the male is bent down over that of the female and during which there may be cloacal contact lasting about one second. He dismounts over the head of the female. So passive is the role of the male toward other tinamous and while standing on top of the female during copulation that in our early observations we believed the male to be the female. Not until we collected both members of a pair in this precopulatory position were we certain that the squatting bird was indeed the female and the bird standing on top the male. Frequently, preening follows copulation, after which the pair resumes feeding.

By contrast to the elaborate and lengthy ceremonies of *Nothocercus*

(Schäfer, 1954) and *Crypturellus* (Beebe, 1925), the precopulatory behavior of *Nothoprocta* is extremely simple. The display by the male and the squatting of the female are merely brief interjections in the follow-feeding pattern. A pair of *Nothoprocta* copulated at different and unspecialized places in their territory, and copulation was not repeated in a short time as it is in *Nothocercus* (Schäfer, *op. cit.*). The aggressive precopulatory role played by the male of *Nothocercus* is also in striking contrast to that of *Nothoprocta*.

Several of the ten copulations that we watched took place with no concomitant display by the male. In these copulations the female initiated the mounting merely by squatting, or by squatting after a short dash. On three occasions a startled male displayed when he was uninterested in copulation. This was observed in a nesting male late in incubation. When he left the nest in the morning he flew to his usual feeding grounds. As he landed a bird ran to him from a few yards away. The male immediately postured. When the aggressor bird was momentarily distracted by a third bird, the male raced away. The aggressor tried to follow him, calling, and once got close enough to make him run again, but the aggressor never caught up with him. Another time when an incubating male met the female who guarded his nesting territory, he fluffed and postured, and the female, as in the usual courtship procedure, darted away about five yards. Instead of giving the expected further display or mounting, however, the male started running from the female, initiating a weaving chase 40 to 50 yards downhill and finally eluding her. On a third occasion display probably occurred as a displacement activity. A male displayed to an attacking bird, turned and chased it 15 to 20 yards, and then both stopped to feed about ten yards apart.

The female is aggressive in courtship as well as in other social behavior. An incubating male left his nest in the afternoon, walked about 50 yards, and stopped to preen, calling occasionally. A female joined him. He continued to preen and paid little attention to her as she busied herself around him, usually a few feet away. Several times she squatted for five to ten seconds within a few feet of him, usually facing him. The squatting sometimes climaxed a run of several feet. Except for one display he ignored her. After two to five minutes of this fawning by the female, he started feeding up the ridge. She followed closely, squatting frequently. After a few minutes a tinamou approached them from uphill. The female soon spotted it and gave chase. The uphill bird finally flew, whereupon the female returned to the nest male. The male almost immediately

postured, first head towards her, then tail; she squatted, and he mounted. On several other occasions as well, copulation occurred after the female had chased another bird.

Defense occurs both on the feeding area and in the neighborhood of the nest and is the responsibility of the female. An area may be used for feeding and courting by at least two pairs, but not simultaneously. The female does much calling on the feeding ground, will drive off other birds who are there when she approaches the feeding area, and may come down to the feeding area from uphill to drive away birds. When a stuffed female dummy was placed on the feeding area, however, two different birds known to be females scarcely reacted to it, indicating that the stimulus for the female's aggressiveness may be the behavior rather than the appearance of another bird. Two birds of unknown sex came within two feet of the dummy but after scrutinizing it, ignored it.

Under some circumstances a female tolerates a bird other than the male she is with on the feeding area, and it seems likely that such single birds are males. On one occasion the female of a follow-feeding pair drove one bird off the feeding area but a short time later ignored another bird feeding within 10 yards of her and her male.

The male may call on the feeding ground, but his calling stops when he is joined by a female.

The nest where most of our observations were made (nest 1) was under a clump of grass (*Festuca dolichophylla*) in a small gully about 250 yards above the valley floor. A female made herself conspicuous in the area around the nest, although she never approached the nest closer than 20 yards. This female was seen to copulate with the incubating male six and four days before the eggs hatched. She spent a great deal of time calling and preening on a small ridge about 25 yards from the nest and from this same vantage point in the course of two hours on one afternoon made four sorties against at least two birds calling from areas farther from the nest. Much of her territorial behavior was directed against a bird that passed through her nesting territory on the way to and from feeding. Neither the defending female nor the incubating male reacted to male or female dummies placed within 20 feet of the nest.

The area commonly used by the nesting pair mentioned above was about 100 by 300 yards (6 acres); part of it was clearly defended nesting territory and part less carefully defended feeding area. In favorable habitat nearby at the same season, we estimate that six pairs occupied about 41 acres (7 acres per pair). They will tolerate nests at least as close as 300 yards, for we found two nests separated by this distance that were being laid in at the same time.



*Nothoprocta ornata*, Department of Puno, Peru. (Upper) Habitat near Vilque, 13,300 feet. Beneath and between the bunch grasses are many small herbaceous plants on which the tinamous feed. (Lower) Nest of this species near Tincopalca, 14,000 ft. A six-inch ruler is included.



## REPRODUCTION AND NESTING

Eight active nests were found near Vilque and Tincopalca in the Department of Puno. All were well concealed either under a clump of grass or under a tola bush (plate 10). The nests are substantial structures of circularly wrapped grass and rest on a foundation built up of dry earth or a mixture of earth and mossy turf. Even when laying has not been completed, the eggs are usually covered with feathers while unattended. In general, nests that are well along in incubation have more feathers about them than do the earlier nests, which shows that the male, which does the incubating, supplies many of the feathers. An incubation patch develops in the male but not in the female. Unfortunately, we were unable to discover which sex builds the nest.

The eggs of *Nothoprocta* are a violet-chocolate color with the glossy appearance characteristic of eggs of the Tinamidae. The shell membrane is considerably tougher than in a chicken's egg. Average dimensions of six eggs, with extremes in parentheses, were: width, 36 mm. (35 to 39); length, 53 (51 to 56); and weight, 39 grams (35 to 44). Completed clutches consisted of 4, 6, 6, 9, 9, and 9 eggs. Two other nests in which incubation had not begun had four and eight eggs, respectively. The number of ruptured follicles in the ovaries of four females about to lay the last of a clutch were 4, 6, 8, and 9. These counts agree well with counts of eggs in nests and show that a single female is able to contribute all the eggs incubated by the male in a nest. Natives in the area stated that the females lay every other day. However, from the weights of the graded series of ruptured follicles in ovaries of laying females, and assuming that the rate of resorption of ruptured follicles is similar in *Nothoprocta* and Ring-necked Pheasants (Meyer *et al.*, 1947), we judge that eggs are frequently produced on consecutive days. One female appears to have laid three eggs, skipped two or three days, then laid daily for six days. Evidence that laying can be irregular was presented by a nest that on March 16 and 18 had seven eggs but that had an additional egg added to it by March 21. The natives also say that incubation lasts 24 days. The eggs in nest 1 hatched 22 days after our observations began, but we do not know when incubation had started.

Figure 1 summarizes our observations on the season of reproduction. Although nesting activity probably centers around March, this tendency is exaggerated in figure 1 because most of our collecting was at this season. Collection of two juveniles (210 and 230 grams) on February 10 proves that some nesting occurred much earlier in the

season. Testes of 13 breeding birds shot in February and March varied from 17 to 22 mm. in length.

In support of Goodall *et al.*, 1951, and of observations on caged *Nothoprocta* (Seth-Smith, 1930), we have found only the male incubating. Three birds collected on nests, one in the morning, one at dusk, and one at midnight, were males; it was always the male who sat on the eggs at nest 1, and the female never came close to them.

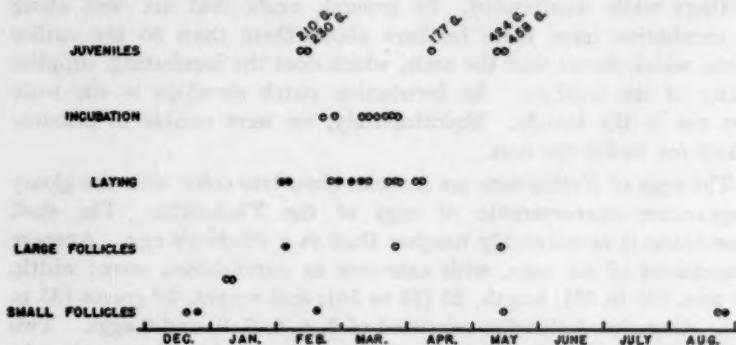


FIGURE 1. Reproductive stages of *Nothoprocta*. The points for incubation are placed at the estimated beginning of incubation for each nest. Solid circles indicate that the specimen was one of a pair at the time of collection.

We watched nest 1 for most of five days and for periods as long as five hours on fourteen other days. The incubation schedule of the male during most of incubation entailed three periods off the nest each day (fig. 2). The shortest time that the male spent off the nest was 40 minutes, the longest, 105, and the average for 16 periods was 77 minutes. The shortest daytime period on the nest was 1½ hours, and the longest period (observed at nest 5 late in incubation) was 7 hours. The morning absence from the nest tended to be longer than the noon and afternoon absences. Perhaps this is correlated with the fact that the mornings are usually sunny and warm and the unattended eggs less likely to chill than in the afternoons during the southern hemisphere summer when cold winds, rain, hail, and snow are frequent. Night temperatures are near or below freezing.

When the male leaves the nest he arranges the loose feathers on top of the eggs, but other parental nesting habits do not seem to have been modified in a way that prevents chilling of the eggs. In spite of the climate, he is off the nest three times as long each day as *Nothocercus*, a tropical relative (Schäfer, 1954). Temperature conditions during the late afternoon feeding of the male on nest 1, who was incubating a clutch that hatched 10 days later, were as follows: 4:00

P.M.—Male left nest. Weather had just become cloudy and windy. Temperature in grass clump similar to that occupied by nest was 12° C. 5:00 P.M.—Air temperature 8°; temperature in grass clump above eggs, 8°; inside of an egg in the nest, 22½°. All eggs covered with feathers except one partly exposed in the center of the nest. 5:35 P.M.—Male returned. Air temperature 6°. On some days the

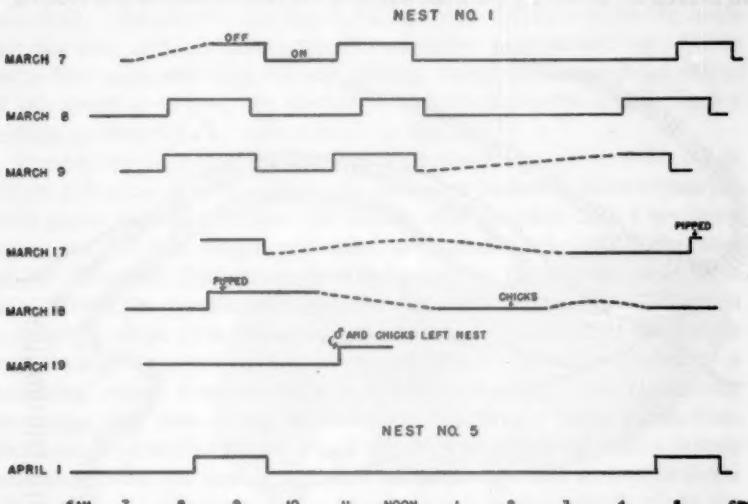


FIGURE 2. Selected records of the incubation schedule of *Nothoprocta*. The bottom diagram is for nest 5, an estimated three days before hatching. Dotted lines cover periods during which we were not watching the nest.

male did not return until after 6 P.M. when the air temperature was even lower.

Another male was shot on a nest at midnight when the air temperature was -2°; cloacal temperature was 39½°. The temperature inside two of the eggs was 35½° and 36°. Three eggs were left in this nest, covered with feathers. Despite the below-freezing night temperature, at noon the next day their temperature was 27° and the embryos (12 to 15 grams) were moving and had beating hearts. Eggs from a different nest were taken to camp overnight and at 6 A.M. had a temperature of 3½°. When the eggs were warmed to 28° and opened, the embryos (5 to 7 grams) moved voluntarily and showed strong heart beats. It appears then that embryos of *Nothoprocta* are resistant to chilling.

As hatching approached, the incubation schedule of the male attending nest 1 changed. On March 15, two days before pipping,

he first left the nest almost two hours later in the morning than was usual, and it is probable that, like the male at nest 5 (fig. 2) about three days before hatching, he took only two recesses on that and subsequent days. On March 15 his behavior while off the nest altered also. On March 14, as on previous days, the male had met and copulated with the calling female who frequented the nesting area. On March 15, however, the male avoided the female, and in one feeding

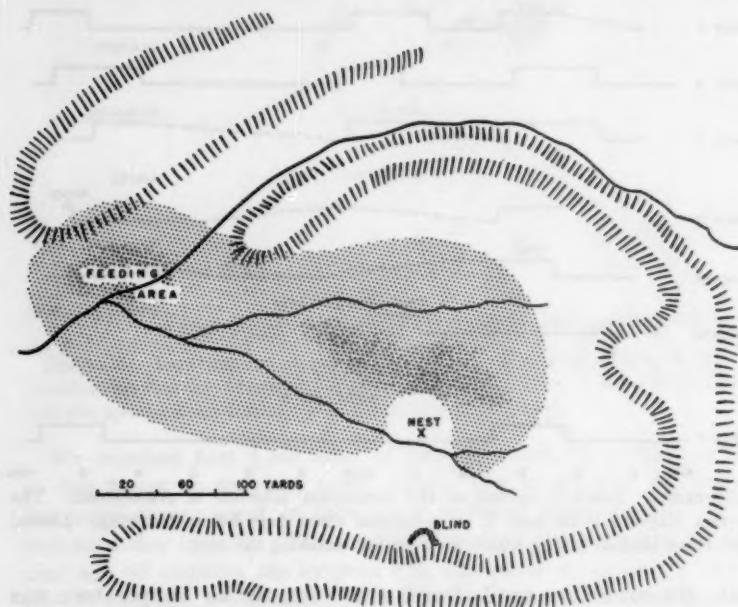


FIGURE 3. Diagram of the area around nest 1, showing the extent of the territory occupied and defended by the female. The degree of stippling is in proportion to the amount of time the female spent in different parts of her territory. The incubating male stayed within the female's territory.

period was twice seen to run and escape from her attentions. Perhaps it was the change in behavior of the male that prompted a change in the behavior of the female that ordinarily guarded the nest area, for during the last few days of incubation she was not seen in her usual places.

When the male leaves the nest he covers the eggs, then walks 20 to 50 yards away before he stops to feed or preen. The male from nest 1 fed mainly at the base of a hill about 230 yards from the nest and blind. Figure 3 is a diagram of the nest area and shows the extent

of the observed movements of the nest male and female. When the male returns to the nest, he moves aside the feathers before settling on the eggs.

The nesting male sometimes called during the periods off the nest and, as mentioned before, may briefly answer calling while sitting on the nest. The female's calling bears some relation to the incubation schedule. Frequently she began calling near the time when the male left the nest, and her calling stopped when the male joined her. While with the male, she may resume calling, using the same short chirp, if she needs to defend her territory. Many times the female begins calling again after the male returns to the nest.

During the time that we watched *Nothoprocta* we saw no evidence of either polygyny or polyandry. No male was known to have copulated with more than one female; the female who guarded nest 1 territory never, to our knowledge, copulated with males other than the nest male. The fact that copulations between the incubating male from nest 1 and the female who guarded his nesting area were observed only four and six days before the eggs hatched suggests that the female was laying, or about to lay, a second clutch. Further evidence of renesting comes from another nest where the male was incubating nine eggs that were about a week from hatching. Sixty yards from this nest, well within the expected territory of a nesting pair, a female was shot with the last of a clutch of nine eggs still in her oviduct. The puzzle is, of course, if the female lays a second clutch while the male incubates and broods the first, how does she find and induce a second male, probably not the father of her second brood, to incubate the second clutch?

In the afternoon of March 17, 22 days after our observations on nest 1 had started, the parent was very restless on the nest for three-quarters of an hour before he left, and he left later than usual for his evening feeding. The five eggs, covered over with feathers, were arranged in a saucer shape, with one egg on top of the others. The egg on top had a hole about 3 mm. in diameter in it, and the shell membrane had also been punctured. Pipping was just starting on the upper surface of the two other eggs that were seen clearly. When the parent left the nest again the next morning the eggs were in the same positions, with one egg on top. The other four eggs had pip marks, but no holes. Apparently there had been no progress in hatching overnight, for the hole in the top egg was still 3 mm. in diameter. Two hours later the male parent was still off the nest, and as we approached we could hear peeping. The top egg, whose opening was now 5 mm. in diameter, had slid over and was no longer on top. The other four eggs were still just pip marked.

The incubating male was increasingly restless as the day passed. He did much poking under and about him with his bill, and preened about the neck and breast. In the early afternoon a large piece of shell popped out on one side of him, and he, in several thrusts, forced it back under himself again. At 2 P.M. the first chick, already dry, popped up in front of the male but was immediately forced under the parent again. At 5:15 P.M., when the sun set on the nest, the male had not left for his evening feeding. There was some calling fairly close to the nest, and the bird stood up, poked into the nest with his bill, and sat down again. We left our blind at 5:45, the male apparently settled for the night. To our knowledge he left the nest only once on this hatching day, in the morning.

On the following day the male was again restless. Several times he stood up and looked underneath himself but did not leave for a feeding. Finally, at 10:20 A.M. a chick climbed out on the edge of the nest and tumbled off onto the ground. The others followed, and all five were out by 10:30. The young were steady on their feet. As soon as they were off the nest they started pecking at the ground and exploring within a distance of two feet. At 10:50, twenty minutes after the last chick had left the nest, the parent stood up and started moving almost imperceptibly down the gully. He was extremely cautious, watching carefully about and paying no apparent attention to the chicks. Occasionally he pecked at the ground and once he fluffed out his feathers and defecated within a yard of the nest. When about  $1\frac{1}{2}$  yards from the nest he circled back to the nest. Three of the chicks gathered at his feet, and he turned and set off down the gully again. The last two chicks straggled well over two yards behind the rest. There was little organization, for the chicks sometimes preceded him a little or wandered about to the sides. No sounds could be heard at the blind 65 yards away. By 11:40 the procession had gone a distance of only 9 feet from the nest. Observations were interrupted until 3 P.M., when a careful search failed to reveal either the brood, the male, or the territorial female. They did not return to the nest, and during the next three days we could not locate them in the area. The abandoned nest was surrounded by a ring of about 12 large droppings. The egg shells were broken into pieces and lay mixed with feathers in the bottom of the nest.

In addition to seeing the above male escort his brood from the nest, we were able to collect an adult attending a brood of at least four young. This bird also was a male. In our two encounters with discrete coveys of half-grown young, we saw only one adult attending each, so it seems likely that the female does not assist the brooding male.

## SUMMARY

*Nothoprocta ornata* lives between 13,000 and 14,300 feet in the grass-covered hills of southern Perú. Both sexes screech when taking flight, and a single sharp chirp is used as a location call and as a territorial call.

During the breeding season the females are aggressive in their social and sexual behavior and defend the nesting and feeding areas. A pair was observed to have a territory of about 6 acres, which included both nest and feeding ground. Only the male sat on the eggs, and the female never came within 20 yards of the nest during the incubation period.

During courtship the members of a pair feed together, the male usually preceding. In display he raises the rump and displays the bright crissum. The female responds with a short dash to a position in front of the male and squats. Mounting may follow.

Clutch size in six completed nests varied from four to nine eggs, with an average of seven. Laying females were found from February through April, although the breeding season is probably longer than this.

An incubating male customarily took three recesses a day from the nest. *Nothoprocta* embryos are resistant to chilling. The precocial young hatched on the twenty second day of our observation of a nest and left the nest permanently about 20 hours later with the brooding male. We have no evidence that the female takes any part in rearing the chicks.

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## MEASUREMENT OF TERRITORY AND HOME RANGE SIZE IN BIRDS

BY EUGENE P. ODUM AND EDWARD J. KUENZLER

At some time during the annual cycle, most vertebrates restrict their activities to a definite area which may be termed the home range. If all or part of the home range is defended against other individuals of the same species, the guarded area is called a territory, according to current usage. Territoriality is an important mechanism which reduces intraspecific competition; it is especially pronounced in nest-building animals (birds, certain fish, insects, etc.) which have complicated behavior patterns requiring highly coördinated actions during reproductive periods. Establishment of territories and home ranges produces characteristic intrapopulation distribution patterns which have important bearing on the choice of census methods (See Odum, 1953, Chap. 6).

Examination of the voluminous literature on territorialism in birds reveals that many qualitative details have been worked out. The "kinds" of territory, such as are listed in the comprehensive review by Nice (1941), have been classified, and the means of establishment and defense of the territory area have been described for many species. On the other hand, many quantitative aspects of territorialism have been scarcely considered. For example, the effect of various populations and habitat factors on the size and configuration of the defended or occupied areas is virtually unknown. A relation between territory size and food supply is often postulated, but we know of no case where the available food supply and the size of territory have both been accurately measured. It is true that numerous estimates made of territory size have been published, but it is evident that many are but crude approximations, often based on less than a dozen spot observations. Very little confidence can be placed in the comparison of measurements made by different investigators because of the great variation in procedures used and in the intensiveness of the observation. It is becoming quite evident that quantitative comparisons of territoriality cannot proceed until sound, consistent methods of measurement are developed.

In this paper the problem of measurements of territory and home range size is critically examined, and a method for standardizing measurements is proposed. The method is illustrated by data obtained in a study of territoriality of seven southeastern species. These data are also used to test certain concepts developed by mammalogists in their parallel studies of home range.

The present study is part of an ecological survey being conducted on the Savannah River Area by the University of Georgia under contract No. AT (07-2)-10 with the United States Atomic Energy Commission. These investigations are designed to establish present population levels and trends of major terrestrial organisms in order to facilitate future analysis of changes resulting from the complete removal of the resident human population and the operation of atomic energy installations, as well as to provide a basis for land management. The Savannah River Area comprises about 200,000 acres on the upper coastal plain in Aiken and Barnwell counties, South Carolina. Since the most feasible method for measuring the density of breeding birds on large areas is the "territory-mapping" method, it was necessary that we obtain data on territory size of important species of the region.

The authors are indebted to Dr. David E. Davis for important suggestions and to Robert Pearson for aid in field mapping. Mr. Karle E. Herde of the Savannah River Operations Office of the Atomic Energy Commission was extremely helpful in making arrangement for carrying out field work.

*The Concept of Maximum Territory and Utilized Territory.*—The method generally used to determine the size of the territory (defended area) or home range (in case the area is not defended) in birds has been to plot the location of the male or the pair at different times directly on a map carried into the field. The outermost points on the map are then connected forming a polygon, the area of which may be determined. If the territory is irregular in shape, as is often the case, differences in area would result depending on how the points are connected to form a polygon. If the extreme outermost points are connected with straight lines so as to include all the other points, a larger area results than if the line is drawn connecting all of the perimeter points. In the former case there is only one polygon possible, while in the latter case one would have to decide, often without observational data, which points were actually the outside boundary or perimeter points. Consequently, it seems best first to measure the *maximum territory* by connecting the extreme points with straight lines as indicated above, and second, to determine by other means what proportion or percentage of this maximum territory is the *utilized territory*. The utilized territory, of course, will depend on the distribution of habitat features within the maximum territory area, the location of singing perches, feeding and nesting sites, and whether the male or pair actually makes use of all the defended area. The concept of maximum and utilized territory is analogous to the

recognized concept of crude and specific (or ecological) density. For example, we might have 20 birds of a particular species on 100 acres of land; the crude density would be 20 per 100 acres. If, however, there were only 50 acres of habitat suitable for the species within the 100-acre tract, then the specific density would be 40 per 100 acres. Likewise, a male or pair might defend or visit points around an area of 10 acres, but actually utilize only half of the area or 5 acres. A similar comparison might be made between crude birth rate and specific birth rate. It is evident that the maximum territory (as well as crude density or birth rates) will be easier to determine than the utilized territory (or specific density and birth rate) yet the latter may often have more biological meaning.

The present paper is concerned with two methods of measuring and expressing the maximum territory or home range, leaving the problem of estimating the utilized territory or home range for further study.

*The Observation-Area Curve.*—Three tracts on the Savannah River Area were selected for intensive study. The first contained mature deciduous woods, pine woods, abandoned fields, and a lake margin. The second site contained an abandoned house site surrounded by abandoned fields and hedgerows. The third study area was a "Carolina Bay," a shallow depression of unknown geological origin covered, in this case, with grassland vegetation. Large maps of each of the tracts were prepared by use of plane table or compass and jake-staff, with distances measured by surveyor's chains and by pacing. Aerial maps were also available. From the base maps sketch maps of portions of the study tracts were made for use in the field as needed.

The commonest breeding species—for example the Kingbird (*Tyrannus tyrannus*), Wood Pewee (*Contopus virens*), Meadowlark (*Sturnella magna*), and Orchard Oriole (*Icterus spurius*)—were studied. When a pair was located, often by first locating the nest, the birds were observed continuously for periods of one-half hour to three hours in the mornings and late afternoons, and the location and activities of individuals at approximately five-minute intervals were plotted on a field map made from the reference base map. The male was given primary attention, but wherever feasible the location of the female was also plotted. All major changes in location were plotted even though they did not occur exactly at the five-minute check times, but observations were standardized so as to yield an average of 12 spot locations per hour. The points were treated as "recaptures" somewhat comparable to those made using live-traps in population studies of mammals. Data on a total of 37 pairs representing 9 species were available for the following analysis.

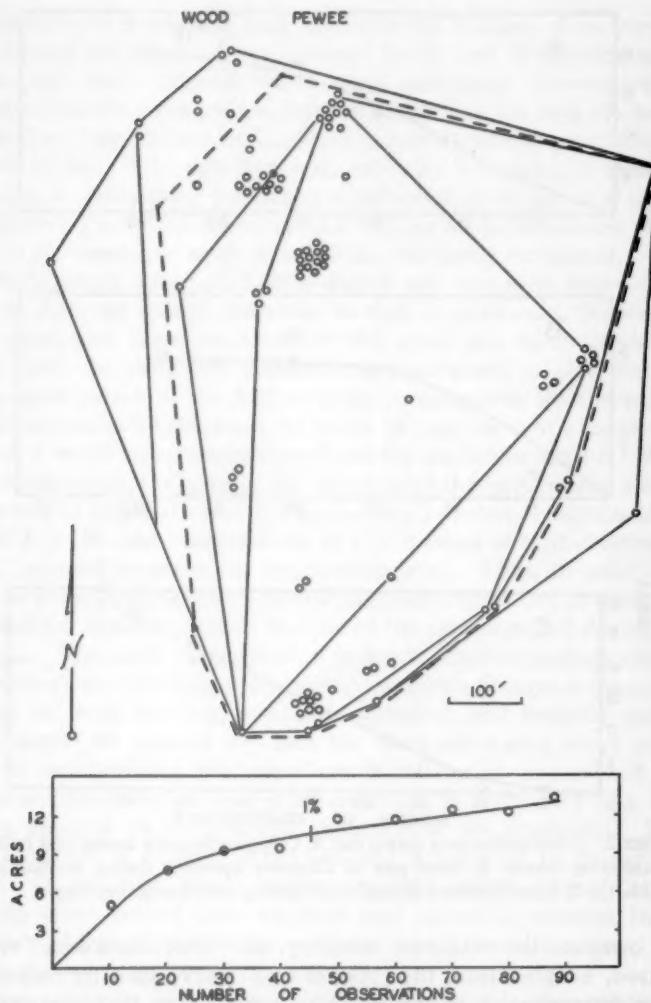


FIGURE 1. Observed positions of a male Wood Pewee at five-minute intervals (small circles) with maximum observed area enclosed in solid lines after successive tens of observations. The broken line in the upper diagram encloses the calculated maximum territory size (10.8 acres) at the one per cent level as shown on the observation-area curve below.

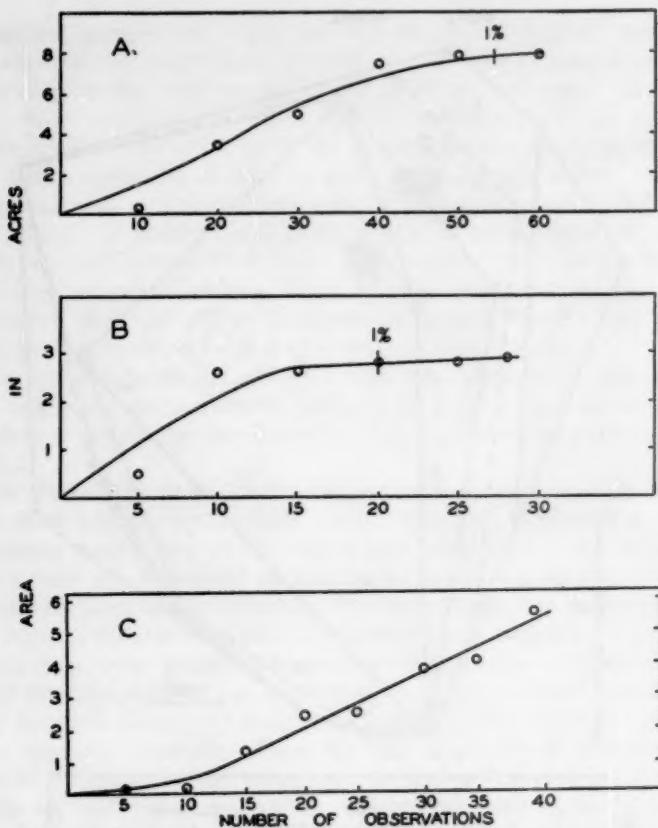


FIGURE 2. Observation-area curves for: A, Chipping Sparrow during nest building and incubation stages; B, same pair of Chipping Sparrows during nestling stage (see table 1); C, Blue Grosbeak during nest building and incubation stages.

To compute the maximum territory, an "observation-area" curve was used, adapted from the "species-area" curve used by ecologists for the determination of the minimum sample area that contains an adequate representation of the species present in a plant community (see Cain, 1938). After each series of 10 consecutive observations, the outermost points were connected as shown in figure 1 and the area of the polygon measured with a planimeter. As the number of observations increased, the size of the area increased as shown in figure 1 with a point being reached where continued observation resulted in little or no observed increase. If the same relative point

on each curve is selected, then a comparable measure of territory size is thereby obtained. A one percent level, that is, a point on the smoothed curve beyond which each additional observation will produce less than one percent increase in the area (or each 10 observations less than 10 percent increase), appears to be a good, practical point to use. Although this is an arbitrary end-point, it represents a point of diminishing returns, it is independent of the total number of observations or the size of the territory, and it is comparable regardless of the species or stage in breeding cycle being considered.

Three other observation-area curves are shown in figure 2. In one of these not enough observations were made to reach the leveling-off point, and therefore, territory size could not be determined in this case. In using this method one would need to plot the areas after each period in the field in order to determine whether enough observations had been made to locate the one percent change level; if not, it would be necessary to continue the field observations. Where the occupied area is large or the behavior of the bird erratic, a longer time will be required. For the species so far studied it was found that from 25 to 90 spot observations, or 2 to 8 hours of field observation, were required to reach the one percent level. Thus, in most cases, two or three hours of observation in the mornings of two or three days sufficed for measurement of the size of the area occupied during that period. This rapid determination makes it possible to study changes in territory size that may occur during successive changes in the nesting cycle, i.e., nest building, incubation, nestling, and fledgling periods.

It should be pointed out that the observation-area curve merely aids in standardizing determinations of the size of an occupied area. Whether this occupied area is to be classed as a territory or a home range depends on the observed behavior of the occupants. Thus, the Kingbird is strongly territorial and defends all of its occupied area. On the other hand, we observed that several pairs of Orchard Orioles often nested close together and shared a common feeding ground. Most of their occupied area would thus be classed as a home range.

Two examples will serve to illustrate how the observation-area curve may be used in the study of fundamental quantitative aspects of territoriality. In table 1 territory size at successive stages in the nesting cycle is compared. In each case, the size of the occupied area was calculated by means of the observation-area curve while the pair was engaged in nest building and incubation. Then, the entire procedure was repeated when the pair was engaged in feeding the nestlings. Since there was no evidence of separate territories

TABLE 1  
TERRITORY SIZE AT THE ONE PERCENT LEVEL AT SUCCESSIVE  
STAGES OF THE NESTING CYCLE

	<i>Nest building and incubation stage</i>	<i>Nestling stage</i>
Kingbird pair No. 1	14.0 acres	9.3 acres
Chipping Sparrow pair No. 1	7.6 acres	2.7 acres
Blue Grosbeak pair No. 1	15.3 acres	13.0 acres

for male and female in these cases, the areas tabulated include that occupied by both members of the pair. In all three species the territory size was much less while the adults were engaged in feeding nestlings than when the pair was engaged in nest building and incubation. If this proves to be a general rule, it would provide strong evidence against the theory that territoriality functions primarily in preserving a food supply, since the area used is smallest when need for food is greatest.

Table 2 illustrates something of the individual variation found in territory size of two species when engaged in the same phase of the nesting cycle, namely, nest building and incubation. The King-

TABLE 2  
VARIATION IN TERRITORY SIZE IN DIFFERENT INDIVIDUALS  
ENGAGED IN SAME STAGE OF THE NESTING CYCLE  
(NEST BUILDING AND INCUBATION)

	<i>Pair number</i>	<i>Acres</i>
Kingbird	1	14.0
	3	35.0
	4	17.5*
	8	16.4
	<i>Male number</i>	
Red-wing	2	1.6
	4	1.1
	5	4.2

\* Narrow territory

bird exhibits type "A" territory, i.e., the male defends the mating, nesting, and feeding ground (see Nice, 1941), whereas in the Red-wing (*Agelaius phoeniceus*), the male defends only the nesting area (type "B" territory).

*Territory or Home Range Expressed in Terms of an Activity Radius.*—Dice and Clark (1953) have pointed out that in many species of mammals the individual has no fixed limits to its wanderings, and therefore, an attempt to ascertain home range boundaries or to express home range in terms of area is unsatisfactory. They suggest that home range in such cases is better expressed in terms of an "activity

radius," and the authors utilize data obtained in a live-trapping study of the white-footed mouse (*Peromyscus maniculatus bairdi*) to illustrate certain possibilities of this procedure. For each marked animal captured more than once a geometric activity center was determined and the distance from this center to each recapture point designated as a recapture radius. When the square roots of 119 recapture radii (representing a number of individuals) were plotted

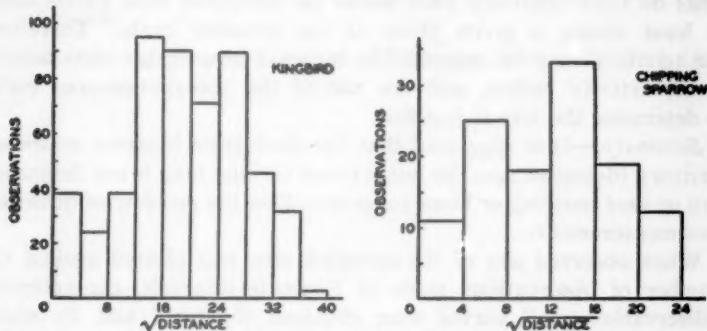


FIGURE 3. Frequency histograms of square roots of 524 activity radii for Kingbirds and 118 activity radii for Chipping Sparrows. For the Kingbird,  $\beta_1$  (a measure of skewness) is 0.0351 (not significantly different from zero), and  $\beta_2$  (a measure of kurtosis) is 2.238 (significantly different from 3 or normal). For the Chipping Sparrow,  $\beta_1$  is 0.0057 (not significantly different from zero), and  $\beta_2$  is 2.032 (significantly different from 3). Thus, both histograms are normal but exhibit platykurtosis.

as a frequency histogram, the resulting curve was essentially normal, exhibiting positive skewness but no kurtosis. Thus, a mean activity radius subject to standard statistical treatments could be calculated. Dice and Clark suggested that if animals defend territories (not the case in *Peromyscus*) their movements would tend to be restricted, which should, theoretically, result in "a certain amount of kurtosis in the frequency curves for the recapture radii."

To test these concepts the same procedures as used by Dice and Clark were applied to our bird data. For each of five pairs of Kingbirds and two pairs of Chipping Sparrows (*Spizella passerina*), a geometric activity center was determined and activity radii measured. Using a square root transformation, the frequency distribution of 524 activity radii for the Kingbird and 118 radii for the Chipping Sparrow is shown in figure 3, together with the calculated values of  $B_1$ —a measure of skewness, and  $B_2$ —a measure of kurtosis. Both frequency curves are essentially normal without skewness ( $B_1$  not

significantly different from 0) but both exhibit platykurtosis ( $B_2$  significantly less than 3 at the 5 percent level). Thus, the prediction of Dice and Clark is borne out by our data. It would seem that testing for platykurtosis in frequency distribution of activity radii is a good method of determining whether an animal's occupied area has a definite boundary as a result of territorial defense or other reasons. We also interpreted these results to mean that territorial birds do have relatively fixed limits (as compared with *Peromyscus*) at least during a given phase of the breeding cycle. Therefore, the territory may be expressed in terms of area rather than merely as an activity radius, and the use of the observation-area curve to determine the area is justified.

*Summary.*—It is suggested that the distinction between *maximum* territory (defended area) or home range (in case area is not defended) and *utilized* territory or home range simplifies the problem of quantitative measurement.

When observed size of the occupied area was plotted against the number of observations made at 5-minute intervals, characteristic "observation-area" curves were obtained (figures 1 and 2), which can be used to standardize measurement of size. The one percent level on the smoothed curve is suggested as a suitable point to use in comparisons; it is arbitrary but represents a point of diminishing returns, is independent of the total number of observations or the size of the territory, and is comparable regardless of species or stage of the breeding cycle.

The use of the observation-area curve is illustrated by a comparison of territory size at successive stages in the nesting cycle of the same pair (table 1) and at the same nesting stage in different individuals (table 2).

An alternate procedure, that of expressing territory size in terms of an activity radius, is tested employing the method used by Dice and Clark in a study of home range in deermice. The frequency polygons for Chipping Sparrows and Kingbirds were essentially normal but exhibited platykurtosis which is interpreted to mean that territorial birds, in contrast to mice, are relatively fixed in their movements during a given phase of the nesting cycle. Therefore, the expression of territory size in terms of area and the use of the observation-area curve are justified.

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*Department of Biology, University of Georgia, Athens, April 14, 1954.*

## SUMMER ECOLOGY OF OCEANIC BIRDS OFF SOUTHERN NEW ENGLAND

BY MALCOLM S. GORDON

BETWEEN June 13 and August 27, 1953, I spent a total of twenty-six days at sea off southern New England on the research vessel *Blue Dolphin*. Some notes on the distribution and ecology of the oceanic birds observed during this period are presented here. Indications of quantitative correlations between hydrographic conditions, food supply, as plankton populations, and bird abundance were found.

More than 95 per cent of the bird observations used in this paper were made by the author. The remainder were made by Dr. Richard H. Backus, of the Woods Hole Oceanographic Institution, and by various members of the ship's company, to whom sincere appreciation is here expressed.

Thanks are also due to David C. Nutt, master of the *Blue Dolphin*, Drs. John C. Ayers, LaMont C. Cole, J. Brackett Hersey, Robert C. Murphy, and Charles G. Sibley, and Messrs. John T. Nichols and Charles F. Powers, all of whom have aided in various ways.

This paper is Contribution Number 742 from the Woods Hole Oceanographic Institution and is part of a thesis submitted in partial fulfillment of the requirements for the degree of Bachelor of Arts with Honors in Zoology at Cornell University.

*Observations.*—The ship worked fairly intensively in two areas, an inshore area hereafter called Area I and an offshore area called Area III. The intervening sea is called Area II. These areas, shown in figure 1, are covered by U. S. Coast and Geodetic Survey Chart No. 1108.

The three areas were visited as follows, an observer being on deck at least 90 per cent of the daylight periods. The numbers in parentheses are the column numbers in table 1 which include observations made on the dates indicated.

Area I: traversed June 13 (1); all day July 11 and 12(2); traversed July 28(3); all day August 4(4); all day August 6(5); late afternoon August 11(6); morning August 12(6); and all day August 13(6).

Area II: parts B and C traversed July 16(1); B and C traversed July 18(2); A, B, and C traversed July 28(3); C traversed July 30(4); C traversed August 7(5); and A and B traversed August 27(6).

Area III: area less than ten miles to the eastward traversed June 29(1); all day July 16 and 17(2); morning and early afternoon July 18(2); all day July 29(3); morning and early afternoon July 30(3); morning and early afternoon August 7(4); and all day each day August 18 through 26(5).

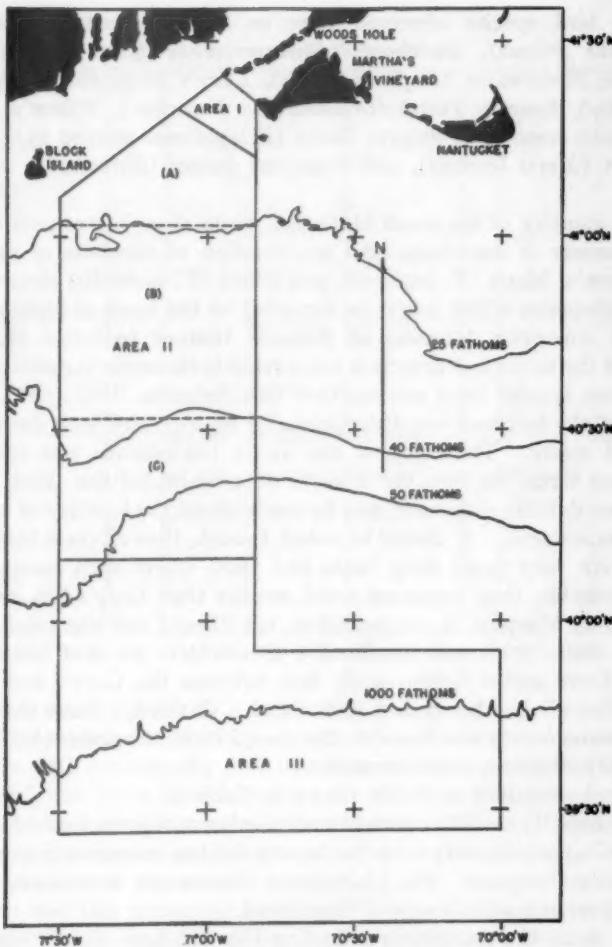


Figure 1. Bird Observation Areas.

The major weather disturbances during the period June 13 to August 27 were as follows: strong lows passed June 14-15 and 18-19; squall line July 3; lows passed July 12-13, 15, 21-22, 23-24, and August 3, 5, and 9; hurricane "Barbara" August 15; and a low on August 19.

Comparisons with Fuglister (1947) show that the sea-surface temperatures throughout the area were normal for the season. The temperature of the surface water in Area III rose from approximately 70° F. to 76° F. between June 29 and August 26.

The bird species observed were as follows: Sooty Shearwater (*Puffinus griseus*), Audubon's? Shearwater (*Puffinus ?lherminieri*), Greater Shearwater (*Puffinus gravis*), Cory's Shearwater (*Puffinus diomedea*), Leach's Petrel (*Oceanodroma leuconota*), Wilson's Petrel (*Oceanites oceanicus*), Frigate Petrel (*Pelagodroma marina hypoleuca*), Gannet (*Morus bassana*), and Pomarine Jaeger (*Stercorarius pomarinus*).

The identity of the small black and white shearwaters seen during the summer is uncertain. An examination of numbers of skins of Audubon's, Manx (*P. puffinus*), and Allied (*P. assimilis*) shearwaters (the subspecies which might be expected on the basis of distribution) in the American Museum of Natural History indicates that the color of the under tail coverts is not a reliable character for distinguishing these species from one another (see Peterson, 1947: 246). The color of the feet was not distinguishable on any bird seen during the present study. The color of the under tail coverts was observed on three birds; on two, the coverts were white, on the third, black. Thus, no definite statement may be made about the identity of all such shearwaters seen. It should be noted, though, that all these birds seen flew with very rapid wing beats and that, where such comparisons were possible, they appeared much smaller than Cory's Shearwaters. Dr. R. C. Murphy, in conversation, has likened the size relation between the Cory's and Audubon's shearwaters to that between a Rock Dove and a Robin, while that between the Cory's and Manx is similar to that between a Robin and a Catbird. Since the Allied Shearwater is only accidental in this area, I think the present birds were probably Audubon's Shearwaters.

The observations made are shown in Table 1.

For Area I: the shearwaters under column 6 were east of Area I proper—approximately over the twenty-fathom curve south of eastern Martha's Vineyard. The Audubon's Shearwater in column 5 was about four miles southwest of Gay Head.

For Area II: the letters following the numbers signify the subdivisions of the Area in which the birds were seen. (B, C) means that the birds were about equally numerous in B and C; (B-C) means that the birds were seen in northern C and southern B. The figures in column 2 are for one half the birds seen on July 18, either in III or IIC (but no distinction made in my notes).

For Area III: the column 2 figures include one half the birds seen on July 18 (see above).

The bird observations indicate the following pattern: oceanic birds were generally scarce in Area I; Wilson's Petrel, while not common,

TABLE 1  
SUMMARY OF OBSERVATIONS ON BIRDS

Species	Area	1	2	3	4	5	6
Sooty Shearwater	I	0	0	0	0	1-2	0
	II	0	1(C)	0	0	0	0
	III	0	3-4	0	0	0	-
Audubon's Shearwater	I	0	0	0	0	1	0
	III	0	0	0	0	15	-
Greater Shearwater	I	0	0	0	0	2-3	1
	II	0	20-25(C)	3-4(B-C)	0	0	0
	III	20-25	60-70	2-3	0	5	-
Cory's Shearwater	I	0	0	0	0	1-2	2
	II	0	40-50(C)	4-5(B-C)	0	0	3(A)
	III	0	75-100	4-6	0	6	-
Leach's Petrel	III	0	2 prob.	0	0	4-5	-
Wilson's Petrel	I	0	5-7	0	0	2-3	3-4
	II	100-150 (B,C)	30-40(C)	3-4(B-C)	0	20-30(C)	10-15(B)
	III	abt. 100	300-380	40-50	0	1000-1400	-
Frigate Petrel	III	0	0	0	0	1 <sup>1</sup>	-
Gannet	I	0	0	0	0	1	1
Pomarine Jaeger	I	3	0	0	0	0	2
	II	0	1	0	0	0	2
	III	1	1	0	0	2	-

<sup>1</sup> Collected August 18 at 39° 48' N., 71° 02' W. See Gordon (1955) for details.

being the most abundant. Areas IIA and B were rather barren, although occasionally Wilson's Petrels were moderately common in B. Area IIC occasionally had numbers of birds present in it but in general was quite barren, except for Wilson's Petrels. Area III usually had a fairly large population of birds. Wilson's Petrels were continuously common and became abundant in late August; Greater Shearwaters were the most abundant of the shearwaters in late June but lost this numerical dominance to Cory's Shearwater in the latter part of July. All of the larger shearwaters became quite scarce in late July and August, while Audubon's Shearwater became the most numerous form in late August. Jaegers were scarce, the only species seen in any of the areas being the Pomarine.

In Area III, the late July decrease in numbers of Greater Shearwaters and the mid-July increase of Cory's Shearwaters were probably due to a completion of the northward migration and to completion of nesting activities and start of post-breeding season wandering, respectively. Similar conclusions were reached by Wynne-Edwards (1935).

The late July and August scarcity of all species of the larger shearwaters is not explained. There was no significant change in the surface temperature of the water covering the area during the summer. It seems unlikely that the small change observed could have been the cause of the great change in population makeup. It is also unlikely that hurricane "Barbara" caused the change, for it apparently began at least three weeks before the hurricane.

The marked increase in Wilson's Petrels and the appearance of many Audubon's Shearwaters in late August seem at least partially explicable by observation. Sargassum weed had earlier been virtually absent from the area. In late August, however, as usual in this region, it became very abundant, carrying with it its usual large community of small animals (shrimp, crabs, fishes, isopods, etc.). The food habits of Audubon's Shearwater and of Wilson's Petrel (Murphy, 1936, and Bent, 1922) make it appear likely that this influx of sargassum was the direct cause of both phenomena. This increase, however, further obscures the cause of the scarcity of the larger shearwaters (especially Cory's), for the food habits of these birds, as described by Bent (1922), are such that one would expect an increase in sargassum to attract them.

A consideration of the variations in abundance and distribution of birds follows. This is made on the basis of two major assumptions:

1. No birds were seen twice. This assumption is considered reasonable due to the wide-ranging habits of the birds involved. Though watched carefully, no shearwaters were ever observed to follow the ship. Wilson's Petrels followed the vessel for varying lengths of time, but never for as long as an entire day. The numbers of petrels recorded daily contain an estimated correction for this duplication.

2. The total number of birds seen in each area is proportional to the total population of birds present in that area at the time. No other assumption in this regard seems justified.

Table 2 summarizes the total bird numbers observed in the various areas during the summer. Column 4 of this table was calculated as follows: Column 2 (observed number) is the sum of all the numbers of shearwaters and petrels observed in each area (see Table 1), using the mid-point of the range when a range of numbers was recorded. Column 4 gives estimates of the numbers of birds that would have been seen in Areas I and III if six days only had been spent in these areas. These numbers were calculated by multiplying the Area I number by 6/7, and taking a random sample of six days from the time spent in Area III (numbering the days from 1-16, the days used were

1, 4, 7, 10, 13, 16—substantially the same results were obtained using other random samples of six days). Differences between the records for the three areas resulting from differing lengths of observing time are thus at least partially compensated for; I believe the "observing effort per unit time" was the same in all areas. The time-corrected numbers bear to one another the relation 1:18:45; the ratio between Areas II and III is 2:2.6.

TABLE 2  
NUMBERS OF OCEANIC BIRDS

Area	Observed number	Observing time (day)	6-day time-corrected number
I	19	7	16
II	280	6	280
III	1910	16	717

"Land shyness" of the oceanic birds may have been responsible for the paucity of birds in Area I (the other areas are completely out of sight of land). It is therefore omitted from further consideration.

The time equalization in Table 2 also roughly equalizes the sea-surface areas observed in each Area. As a first order approximation, the *Blue Dolphin* may be considered to have steamed at a constant speed throughout each of the twelve days involved in Areas II and III. Since, on the basis of the vessel's tracks, about the same amount of overlap of observed areas appears to have occurred in each area, approximately equal areas of sea-surface were observed. The 1: 2.6 ratio between Areas II and III thus appears to be the best estimate of the "true" ratio available.

It should be pointed out that approximately one-third of IIC is covered by water of greater than fifty fathoms depth, hence rightfully belongs in the Slope Water area (Area III—see Miller, 1950). The above treatment of the data and the roughness of the known time-distribution of the records do not allow any reasonably simple correction of the bird ratio for this effect. Suffice it to say that the ratio would be somewhat increased by any such correction.

Why such a distribution exists now becomes a question. The uniformity of the birds' immediate aerial environment makes it seem likely that something in the sea is responsible, probably food supply.

The dependence of sea-birds on planktonic food or plankton-dependent food has previously been pointed out by Jesperson (1924, and other papers). Wynne-Edwards (1935) considers Jesperson to have shown clearly that food supply is "the chief controlling factor

in regulating local abundance of plankton-feeding birds." Off southern California, Miller (1936, 1940) has shown qualitatively a correlation between oceanic bird abundance and the edge of the Continental Shelf similar to that shown here. He considered it likely that plankton population sizes were significant in this. Redfield (1941) has also demonstrated an apparent direct qualitative correlation between plankton abundance and oceanic bird abundance (primarily for Wilson's Petrel) during the summer in the Gulf of Maine.

An analysis of plankton population figures for the areas studied here has been made. Two hypotheses, possibly alternatives, possibly supplementary to one another, have been developed. On the basis of present knowledge no indication of preference for one or the other seems justified.

First hypothesis: Hydrographic conditions in the water masses covering Areas II and III (the Continental Shelf and Continental Slope waters, respectively) are such that it would seem likely that Area III can maintain a larger total plankton population than Area II (Iselin, 1936; Miller, 1950; Riley *et al.*, 1949; Sverdrup *et al.*, 1942). Data showing that this actually is the case, in the summertime, are presented by Riley and Gorgy (1948).

Phytoplankton population figures (see table on p. 121 of Riley and Gorgy) are indicative of this but, unfortunately, are inconclusive. Figures for total zooplankton, based on observations made in the areas here being discussed, are as follows: From surface to near bottom on the Shelf, and for the upper 800 meters in the Slope area, "the averages for total zooplankton were of the order of 30 gm. wet weight per square meter of sea surface in the coastal zone . . . and upwards of 80 gm. in the slope water area" (Riley and Gorgy, p. 116). From these figures the zooplankton population ratio of coastal (Shelf) to Slope water is 1:2.7.

These figures become pertinent to the present hypothesis when the occurrence of "deep scattering layers" is noted in Area III (see Hersey, Johnson, and Davis, 1952, and various of the papers referred to in their bibliography). An at least partially similarly behaving phenomenon was observed fairly consistently in Area II in the course of the present work. In Area III during the months of July and August the fauna of the deep layers appears to be primarily copepods, amphipods, euphausian shrimps, and fishes (mostly small lanternfishes of the family Myctophidae).

Data on the food habits of the birds under consideration here (Murphy, 1936, and Bent, 1922) indicate that the shearwaters feed

primarily on fish, squid, crustacea, and almost any reasonably edible oily substance. Both Wilson's and Leach's petrels feed primarily on crustacea—especially euphausians for Wilson's—small fish, and oily substances. Thus the birds eat exactly what occurs in the scattering layers.

However, the scattering layers are at the surface at night only. Do the birds feed at this time?

No reference to this problem has been found in any of the papers on oceanic birds consulted. However, from the fact that most of these birds are very active during the night while on their breeding grounds (Bent, 1922), also from my own observations of large amounts of nocturnal activity among Leach's Petrels at sea, it does seem reasonable to suppose that at least some feeding goes on in the dark.

There are usually casualties of the previous night's activities floating on the sea-surface (at least in Area III) in the morning, however. Many times during the course of the summer I observed dead squid (deep water forms possessing photophores) floating about. It may be that the birds do not feed at night but merely clean up the battleground after the war has retreated.

In addition, fairly extensive schools of small silvery fish were observed on several occasions during the daytime swimming near the surface in Area III. Schools of Round Herring (*Etrumeus teres*) were similarly observed in Area IIA. All these fishes are probably fed upon by the birds. The fishes in Area III were probably, the Round Herring almost definitely, feeding upon plankton.

Clarke (1940) supplies further evidence regarding this hypothesis, at first glance contradictory.

Clarke states that the Shelf water appears to support more plankton than the Slope water. This, however, is based upon a consideration of tows made throughout the year. When Clarke's summer data (between May 28 and September 3) alone are considered, essentially the same conclusion is reached as was reached by Riley and Gorgy (1948). Clarke's station 4 (apparently right over, or very near, the 100-fathom curve) is within the Slope area as defined in this paper; further, his Slope area tows went down to only 275 meters, hence only his night tows in this area sampled the entire significant population. Comparisons between summer night tows in the two areas give an average total plankton population ratio of 1:2.4.

Fairly strong evidence thus exists for a reasonably close quantitative correlation between bird population size and total plankton population size. A weakness exists in the above argument, however, which allows a somewhat different interpretation also to be made.

**Second hypothesis:** As was pointed out above, the large numbers of Wilson's Petrels observed in Area III in late August (which make up the greatest part of the birds observed in Area III) may well have been feeding upon the animals carried by the surface-drifting sargassum weed. These animals are certainly not considered in any of the plankton figures presented by either Clarke or Riley and Gorgy. One might, therefore, easily say that the correlation indicated above is merely fortuitous and, while interesting, has little significance. No way of correcting the present data for this effect is available. It might be pointed out, though, that Clarke (1940) gives figures for total plankton population in the upper twenty-five meters, for daytime hauls during the summer, that give an Area II: Area III ratio of 1:0.28.

It thus seems apparent to me that the critical observations regarding the relations of oceanic birds to their watery substratum are still to be made. Analyses of the stomach contents of petrels and shearwaters taken very shortly after sunrise and also at a variety of times of day in areas having abundant sargassum weed are needed before any reasonable approach to the difficulties mentioned may be made. That there is a correlation between food supply and bird abundance, however, seems quite clearly demonstrated.

**Summary.**—Observations of oceanic bird occurrence and distribution were made during the course of twenty-six days at sea off southern New England between June 13 and August 27, 1953. The areas covered and the observations made are described, and weather and sea-surface temperature data are presented.

Off southern New England in summer, oceanic birds appear to be more numerous, by a factor of 2.6, over Continental Slope water than they are over Continental Shelf water. The major mixing processes occurring in these water masses appear to supply more nutrients to the plankton of the Slope water than to that of the Shelf water. The ratio of total zooplankton populations of the Shelf water to those of the Slope water is 1:2.7. A consideration of "deep scattering layer" behavior and known feeding habits of the birds makes this appear to be something more than just an interesting parallel. However, deficiencies in our present knowledge, combined with complication of the food supply picture owing to the appearance of sargassum weed in the study area, do not allow definite conclusions to be reached. In any case, the general correlation between seabird abundance and food supply, first pointed out by Jesperson, seems strongly supported.

Temporal variations in species abundance of various of the birds

are also considered. Possible reasons for these variations are discussed. The field identification of the western North Atlantic species of small black and white shearwaters is considered, with the conclusion that sight identifications are not trustworthy.

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*Department of Zoology, Yale University, New Haven, Connecticut,  
February 2, 1955. (First submitted March 26, 1954.)*

NOTES ON THE LIFE HISTORY OF TRAILL'S  
FLYCATCHER (*EMPIDONAX TRAILII*)  
IN SOUTHEASTERN WASHINGTON

BY JAMES R. KING

THE recent growth of interest in the nesting ecology, voice, and habits of Traill's Flycatcher (*Empidonax traillii*) in relation to the taxonomic segregation of this species into its several races prompts me to record these observations on the hitherto neglected western race, *E. t. brewsteri*. Recurrent disagreements and difficulties regarding racial differentiation, particularly in the West (*cf.* Aldrich, 1951; Phillips, 1948; Miller, 1941), render field studies of Traill's Flycatcher in various parts of its range an especially pertinent adjunct of taxonomic studies based on museum skins, as Berger and Parmelee (1952) have previously stated. Although the present study is not aimed at a principally taxonomic target, items of potential taxonomic significance, such as voice and nesting habitat, have been given special emphasis and are compared with similar phenomena elsewhere in the range of the species. The population of *Empidonax traillii* discussed below lies within the range of the proposed race *adastus* (Oberholser, 1932; Aldrich, *in litt.*), but the older racial name must be retained in this paper, pending acceptance of *adastus* by the American Ornithologists' Union's Committee on Classification and Nomenclature of North American Birds.

The area concerned in this study is a tract of approximately two hundred square miles lying north and northwest of Pullman, Whitman County, southeastern Washington. During the spring and summer of 1952, I was afield during 121 days and engaged in a general survey of the breeding bird population by intensive studies at 5 major and 11 minor stations and by extensive periodic reconnaissance trips throughout the tract. Although this study was not devoted to any particular group or species, it yielded a thorough qualitative appraisal of the habitat distribution of Traill's Flycatcher and much preliminary data concerning its behavior and nesting ecology. I examined 22 nests in 1952, but it was not possible to revisit them regularly, and only partial histories were obtained. During 1953, I was able to spend only late afternoon hours and an occasional weekend in the field between 15 May and 30 August. Most of this time was utilized in the intensive study of a restricted population of Traill's Flycatchers four miles north of Pullman, although some time was also spent in observation and nest-searching throughout the area studied the previous year. Information on the growth of nestlings, population

density, and further data concerning nesting ecology and the voice and behavior of the adults were obtained. Twenty nests were examined during this year, and essentially complete histories were obtained for many of them.

I should like to thank the following persons for generously giving their time in critical reading of the manuscript and for their many helpful suggestions: Dr. Andrew J. Berger, University of Michigan, and Dr. H. K. Buechner, Dr. Irven O. Buss, Dr. George E. Hudson, and Mr. Ernest E. Provost, all of the State College of Washington. My sincere thanks also go to Dr. John W. Aldrich of the United States Fish and Wildlife Service for his counsel on certain aspects of the problem and to Mr. C. F. W. Muesebeck, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, through whose courtesy certain ectoparasites of *Empidonax traillii* were identified.

*Physiography of the study area.*—The general topography of the study area is one of mature, dune-like hills which originated in early Pleistocene time as windborne deposits of dust stripped from the arid lands to the west and southwest (Treasher, 1926). These are the so-called Palouse Hills of southeastern Washington and adjacent Idaho, lying at middle altitudes between the forested Bitterroot Range and the arid semi-desert of central Washington. The general altitude of the study area is about 2500 feet, and a series of "buttes" which extend into it from the nearby mountains of Idaho rise abruptly above the rolling hills to heights of 3650 feet. A dendritic pattern of streamlets dissects the uplands, but only the north and south forks of the Palouse River, bounding the study area on three sides, and one or two of their larger tributary creeks, maintain a permanent flow. Because of the porous nature of the soil and the great depth to bedrock there are no natural lentic bodies of water in the area. Springs and percolation sinks which might support marsh vegetation are uncommon and frequently are dry by midsummer.

The aboriginal vegetation of this portion of the Palouse Hills was a climax of prairie grasses dominated by *Festuca idahoensis* and *Agropyron spicatum*, with interspersed communities of brush species (Daubenmire, 1942). During the past fifty years most of the prairie vegetation has succumbed to the plow, and it is only in gullies or on north slopes too steep to cultivate that remnants of the prairie persist as "islands" in the sea of wheat. These dry upland remnants are often dominated by their shrubby elements, such as hawthorn (= western black haw, *Crataegus douglasii*), chokecherry (*Prunus virginiana* var. *melanocarpa*), snowberry (*Symporicarpos rivularis*),

and roses (*Rosa* spp.). Along creeks and streamlet valleys, hawthorns, frequently assuming the stature of small trees, form extensive thickets, and there is an undergrowth and edge growth of shrubby willows (*Salix* spp.), rose, reed canary grass (*Phalaris arundinacea*), and many rank forbs, among which cow parsnip (*Heracleum lanatum*) is the most conspicuous. In certain stream valleys the dominant hawthorn trees are separated by areas of low meadow grasses and forbs, giving an open, park-like aspect. Locally, on the narrow flood-plain of the Palouse River, stands of black cottonwood (*Populus trichocarpa*), quaking aspen (*Populus tremuloides*), mountain alder (*Alnus tenuifolia*), and caudate willow (*Salix caudata*) may form rather dense groves, with a shrub stratum, often, of lesser willows, chokecherry, hawthorn, and other species. Coniferous vegetation invades the area from the east via the north exposures of the aforementioned "buttes" and the relatively deep North Palouse River Canyon. Ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga taxifolia*) are the dominants of two rather distinct zones which occur in a mosaic in these situations. Extensive chaparral-like thickets of ninebark (*Physocarpus malvaceus*) occur as open stands in clearings and along the forest edge. A well-defined stratum of shrub species is present in the pine woodland but is scant or absent in the more dense Douglas fir forest.

The climate of the Palouse Hills is characterized by wet, cool winters and warm, dry summers. About seventy per cent of the annual rainfall, which averages approximately twenty inches, occurs between mid-October and late March. July temperatures average 62° F., and midsummer highs of 104° F. have been recorded at Pullman (Fisher, 1941). The weather during 1952 and 1953 will be discussed in conjunction with the nesting season during those years.

*The pre-nesting season.*—The main wave of spring migrants of *Empidonax traillii* arrives at Pullman in late May or early June. My earliest records for more than single birds in 1952 and 1953 were, respectively, 29 May and 8 June. The fourteen-year study by Hudson and Yocom (1954) reports an early date of 28 May for southeastern Washington in general. Shaw's (*in Jewett et al.*, 1953) date of 10 May 1920 for Pullman is an exceptionally early one. The infiltration of the nesting habitat was rapid in 1952, and it would appear that essentially the entire nesting population arrived in the area within a period of six or seven days. Pairs and trios engaged in vigorous sexual chase, and others, apparently already mated, were observed as early as 1 June during that year, making it plain that males and females arrived here almost simultaneously.

Territorial disputes among males are frequent and violent during the pre-nesting period, and occasionally an invading male is attacked by both members of a territorial pair. Rarely this attack involves physical contact, but typically consists, after preliminary vocalizations, of a swift and intricate pursuit flight and much additional calling on the part of both defender and invader. Participation by females in pursuit flight, in three recorded instances, did not go beyond a single swoop at the invader. These birds were identified as females by their silence and by their close association with the defending males.

By the time the laying season began there was rarely any territorial fighting in populations which I observed (although the querulous twittering of the intimidation call could occasionally be heard), and territorial boundaries seemed to be well adjusted. The reputed pugnacity of Traill's Flycatcher toward birds of other species (*vide* Wheelock, Bendire, *in* Bent, 1942: 202; Dawson and Bowles, 1909: 389) is either much over-rated or does not apply to the species in this area. I have recorded only one instance of such behavior, the harassing of an Eastern Kingbird (*Tyrannus tyrannus*).

*Habitat.*—As with populations of *Empidonax traillii* in the East and Midwest (Snyder, 1953; Berger and Parmelee, 1952; Meanley, 1952; Campbell, 1936), this species nests in xeric uplands as well as relatively mesic riparian sites in the Palouse Hills. However, this is apparently not the case throughout the West, and certain authors report the species only from moist, brushy habitats. Grinnell and Miller (1944: 257) in California found *E. t. brewsteri* "strikingly restricted to thickets of willows, whether along streams in broad valleys, in canyon bottoms, around mountain-side seepages, or at the margins of ponds and lakes." Sumner and Dixon (1953: 123) offer an almost identical analysis for the Sierra Nevada, and Dawson (1923: 885) also emphasizes an affinity for willows in California, adding that Traill's Flycatcher is "a lover of the half-open situations, brushy rather than timbered, of clearings, low thickets, and river-banks." Hand (1941: 227), in northern Idaho, found the species limited during the breeding season to "willow-bordered mountain streams or brushy deciduous growth in the larger valleys." Behle (1943: 46) reports a similar habitat preference in southwestern Utah. For Oregon, Gabrielson and Jewett (1940: 395) mention only "wooded stream bottoms."

In Washington in particular, Rathbun (*in* Bent, 1942: 198) analyzes the habitat of *E. t. brewsteri* west of the Cascade Range as "quite open places more or less overgrown with shrubs or bracken or both, the

location of which is along the margin of a mixed growth of trees, mostly deciduous, with water or low ground not far away." In southeastern Washington, Traill's Flycatcher is not confined to streamside brush or even to moist sites, and as Wing's (1949) census emphasizes, may be found also in dry, brushy prairie remnants in the uplands. Dawson and Bowles (1909: 389) mention in passing an apparently similar dry-land occurrence in western Washington. Dumas' (1950) extensive analysis of breeding bird distribution in two counties south of the Snake River in Washington reports Traill's Flycatcher in substantially the same range of vegetation types in which I have found the species in the present study area. This habitat may be divided, on the basis of floristic differences, into four general segments: (1) riparian hawthorn thicket, (2) the shrub stratum of the less dense portions of flood-plain forest, (3) upland prairie remnants containing hawthorn, chokecherry, or rose, and (4) dry ninebark thickets at the lower edge of the coniferous forest zone.

In an area such as the Palouse Hills, where Traill's Flycatcher is found in nearly all vegetation types containing a shrub stratum (for exception see below) and where the ecological edge effect (Leopold, 1936: 131) is emphasized by the small size or irregular configuration of brushy habitats, it is practically impossible to discover, through observation of the presence or absence of the bird, even the major factors determining its habitat selection. This is unfortunate, since the phenomenon of habitat selection is manifestly an inherent behavior pattern (Beecher, 1942), and an analysis of the factors involved could conceivably shed much light on the suspected ecological segregation of the various races of *E. traillii*. Although the vegetation types selected by Traill's Flycatcher in the Palouse Hills have certain features in common, from the human conception of the demands that the nesting economy makes upon the vegetation, there is no rigorous method of determining the importance of these factors to the bird itself. However, for purposes of comparison with populations of *E. traillii* in other areas, the more salient ones will be briefly noted.

The shrub lands occupied by Traill's Flycatcher are in general quite open, with the bushes well spaced in the subordinate herbaceous vegetation. The few remaining dense, extensive thickets are typically bordered by open fields, and it is on this edge that Traill's Flycatcher is found. In the flood-plain forest, the bird likewise avoids the dense alder and willow thickets and is found on the higher benches where the shrubs are more widely spaced and less shaded. The species does not penetrate deeply into the coniferous forest zone but is found only along its lower edge or where a lobe of prairie vegetation or ninebark thicket extends into it.

*Nesting substrate.*—The concept of nesting substrate as an important limiting factor in habitat distribution has been thoroughly discussed by Beecher (1942). Detailed remarks concerning nest-site selection appear below, and it is sufficient here to point out that a suitable habitat must provide low crotches or forks of branches sufficiently small that the sides of the nest may be woven to them. Suitable sites of this type are found in all of the brushy draws and slopes of the Palouse Hills, and Traill's Flycatcher occurs in all of them except the understory of the coniferous woods. It is interesting to note that here the niche is occupied by Wright's Flycatcher (*Empidonax oberholseri*), whose habits are very similar to those of Traill's Flycatcher. These two species may be found nesting almost side by side at the lower edge of the pine woods on the slopes of certain of the "buttes" in the study area and also along the pine woods occupying the canyon slopes of the North Palouse River, but in the interior of the forest and higher on the slopes Traill's Flycatcher is absent.

*Song perches.*—Many miles of rose-snowberry thicket fringe rural roads and fencelines in the uplands, but Traill's Flycatcher, in my experience, does not occur in this vegetation type except where a hawthorn or chokecherry bush rises above the lower thicket, or where a low-hanging telephone line occurs. I believe that its occurrence in rose-snowberry thickets is dependent upon the presence of an elevated, exposed song perch. In view of the conspicuous role of song and song periodicity in the sexual cycle of this species, it would be very reasonable to assume that a strong perch predilection accompanies singing behavior. Lack (1933: 247) has demonstrated a similar habitat requirement in the Tree Pipit (*Anthus trivialis*) in England. Low perches, such as fence wires, are not consistently utilized as territorial song posts, and I have never observed them used as perches during the twilight song period. In general, the principal song perches are the highest exposed twigs in the territory, and they vary from about seven or eight feet above the ground in the lower shrubbery of the uplands to as high as 28 feet in the arborescent hawthorns of the riparian thickets. It is quite common during the early part of the evening song period to drive along the edge of a thicket and see Traill's Flycatchers silhouetted against the pale background of wheatfields, each bird perched on a high, bare twig.

Shade, cover, and water for drinking seem to have little or no influence on the distribution of Traill's Flycatcher in this area. Some territories, such as those in openings of the hawthorn thicket, include a dim, shaded retreat beneath the closed tree crown; others are barren of shade for either adults or for the nest, with the exception of whatever shade is afforded by a few overlapping leaves. Although the species

is rather retiring, it is not skulking or furtive. Dense refuge cover is not required, and a thin screen of rose leaves may serve as well as any other type. The availability of surface water is likewise not a requirement, at least not after the early part of the nesting season. The average estimated distance of 40 nests from surface water was 123 feet, between the extremes of 3 feet and 600 feet. In many cases water sources were dry before the nesting cycle was complete, and often before the eggs had hatched. Dew-fall in the Palouse Hills during the summer months is extremely rare.

*Nest site.*—Traill's Flycatcher chooses a nest site providing a vertical crotch, or a horizontal or slanting fork providing support from below. This latter feature is apparently essential, since the first stage of nest-building consists of placing a wad of soft strips of vegetation in a crotch as a platform for further construction. In addition, the nest site must provide twigs of small diameter ( $\frac{1}{8}$ " to  $\frac{1}{4}$ ") to which the nest may be woven. Cover is not an essential factor, for nests are as frequently found in exposed sites as in well-hidden ones. Traill's Flycatcher in this area seems to have a very definite nest-height preference, 34 of 41 nests (83 per cent) were between 20 inches and 40 inches above the ground. This preference is especially noticeable because nesting crotches apparently identical to those used are available at much greater heights. The height of nests above the ground, the substrate species, and crotch type are given in table 1.

TABLE 1  
NEST SITES OF TRAILL'S FLYCATCHER IN WHITMAN COUNTY, WASHINGTON

Substrate	Number of Nests	Height above Ground Average	Extremes	Crotch Type Horizontal	Vertical
Rose ( <i>Rosa</i> )	15	35"	24-61"	1	14
Hawthorn ( <i>Crataegus</i> )	8	32	16-53	6	2
Cow parsnip ( <i>Heracleum</i> )	7	27	16-36	—	7
Choke cherry ( <i>Prunus</i> )	5	32	20-42	—	5
Ninebark ( <i>Physocarpus</i> )	3	36	34-38	1	2
Willow ( <i>Salix</i> )	1	—	66"	—	1
Cottonwood ( <i>Populus</i> )	1	—	28	—	1
Groundsel ( <i>Senecio</i> )	1	—	26	—	1
Apple ( <i>Malus</i> )	1	—	61	—	1
Totals and Averages	42	32.4	16-66	8	34

Berger and Hoflund (1950: 9) give 49.5 inches as the average height above the ground of 17 *Empidonax traillii* nests in Michigan, with extremes at 41 inches and 63 inches. Other nesting heights were estimated up to ten feet. Meanley (1952) reports the average height of 15 nests (13 of which were in *Crataegus*) as 7.5 feet in Arkan-

sas. Howsley's records (*in Bent*, 1942: 199) from western Washington give an average nest height of three feet, between the extremes of 30 inches and 5.5 feet. Other western nests have been found as high as 18 feet (*Bent*, 1942: 200).

In shrubs, the nest is almost invariably placed in the peripheral foliage, and in thickets it will typically be found in the outer edge, a situation also noted by Berger and Parmelee (1952: 37) in Michigan. This choice may in part be dictated by the habit of the female of approaching the nest in a single swoop, when she is unaware of the observer, without any preliminary skulking. This habit has also been recorded by Farley (1901: 355) for *Empidonax traillii* in eastern Massachusetts.

*Structure of the nest.*—Two general nest types may be described for Traill's Flycatcher in the Palouse Hills: a deep, relatively thick-walled structure usually found in vertical crotches, and a flat, relatively thin-walled type usually found in horizontal or slanting forks. In reality, these "types" are the extremes of a series, form being dependent upon the mechanical support afforded by the substrate, and many intermediate nests have been observed which are "typical" of neither those in vertical nor in horizontal supports. There is a definite tendency, however, toward more bulky nests in vertical crotches, and less bulky nests in horizontal forks. Much comment has been given in the literature regarding the apparent geographical segregation of two nest types referred to as "Yellow Warbler-like" and "Song Sparrow-like" (*vide* Aldrich, 1953; Snyder, 1953). The two extreme "types" which occur in this area superficially resemble, on the one hand, the compact nest of the Yellow Warbler (*Dendroica petechia*), and, on the other hand, the more bulky and ragged nest of the Song Sparrow (*Melospiza melodia*). There is no correlation between these nest types and the habitat in which they are found or behavior of the Traill's Flycatchers which constructed them. I can only conclude that they are normal structural variants within the population of *Empidonax traillii* here discussed.

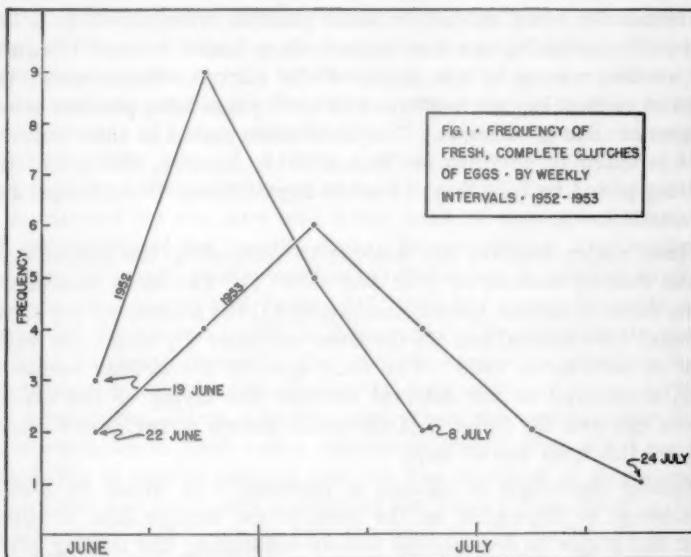
The structure of the nest is best described with reference to the building program. Although I have not been able to observe the construction of any nest from start to finish, I have examined nests in many phases of construction. When placed in sequence, these observations agree closely with those of Howsley (*in Bent*, 1942: 199) with regard to the building program: *Stage 1*: the piling of soft bark strips, dried grass leaves, or plant floss in the selected nesting site. In a vertical crotch, this material is simply laid at the point of divergence of the component stems; in a horizontal or slanting fork the material is placed usually upon a complex of underlying interwoven stems of the nest bush. It serves simply as a foundation or filling, and its mass is dependent apparently upon the distance from the supporting twigs

to the point where the nest structure may be woven to the selected fork. In vertical crotches the mass of the foundation material is seemingly a function of the angle of divergence of the component twigs of the crotch. The narrower this angle is, the greater the distance from its base to a point where its diameter will accommodate the rim of the finished nest. Much loose foundation material is required in such a site, and this fact no doubt accounts for the typically ragged and bulky nests in vertical crotches. Occasionally the foundation material is bound with a few strands of animal silk. *Stage 2:* When the foundation material is sufficiently deep, a cradle is next woven upon it. Loose ends of foundation material are incorporated in this cradle which joins the twigs of the nest site and serves both to anchor the nest and as a receptacle for additional nest material. Soft, pliable strips of plant tissue are used in its construction. *Stage 3:* Additional loose material is next placed in the cradle until there is a sufficient mass to support the cup of the nest. *Stage 4:* The rim and cup of the nest, unlike the major bulk, are sturdily and rather neatly constructed. Upon the secondary foundation material in the cradle, stiff, dry grass stems are laid and turned to form a tight rim. Infrequently, a binding of animal silk or strands of *Populus* floss may be added. The bird applies this material using the mandible like a trowel, at the same time squatting in the cup of the nest and turning around and around, shaping the cup to its body. The lining of the cup is woven from wiry rootlets or stiff grass stems, and often from both. An inner layer of horsehair was found in two nests. Materials which contribute nothing to structural integrity, such as wads of plant floss, or one or two feathers, are occasionally included in the rim or outer bulk. These are not present in conspicuous proportions. Two features of the nest of Traill's Flycatcher are very frequently observed, and almost constitute "key" characteristics. These are the tangential protrusion of the ends of the long grass stems used in the construction of the rim of the nest, and the occurrence of one or two long grass stems dangling from the major bulk of the nest.

The average and extreme dimensions of 20 nests (five from horizontal forks, 15 from vertical crotches) from the Palouse Hills are, in inches: *cup diameter*, 2.1 (2.0-2.2); *cup depth*, 1.5 (1.4-2.0); *outer (maximum) diameter*, 3.4 (3.0-4.0); *outer depth*, 3.3 (2.2-4.9). Stevenson (1942:68), for an unspecified number of Pacific States nests, gives these dimensions, in the same order, as: 2.1, 1.4, 3.7, 2.3. Berger and Hofslund (1950:8) report these dimensions for 28 *Empidonax traillii* nests in Michigan as: 2.15 (1.75-2.25), 1.38 (1.00-2.00), 2.54 (2.13-3.00), 2.53 (1.88-5.00). As might be anticipated, the dimensions of the cup vary within narrower limits than do the overall dimensions.

*Population density.*—Wing (1949) found an average of 9.2 breeding pairs of Traill's Flycatchers per hundred acres of Palouse prairie during a five-year study. My 1953 study plot on Missouri Flat Creek, four miles north of Pullman, contained 12 nests (10 found plus two estimated) on 86.5 acres, or 14 breeding pairs per one hundred acres. This census area is a rather narrow strip of alternately dense and open hawthorn thicket along a running stream. Other major vegetation of the plot consists of thick stands of cow parsnip, particularly in clearings and along the edge of the more dense thicket, fence-rows of dense rose shrubbery, and a few bushy willows along the stream bank. The thicket is sharply delimited on the south by open wheat and pea fields and bordered on the north by a railroad,

county road, and more open fields. The foraging areas of the flycatchers extended only a few yards into the wheatfields on the south, and rarely further than the road on the north. In measuring the area of the sample, by plane table and planimeter, these facts were utilized in fixing its boundaries.



Traill's Flycatchers are locally rather common in the flood-plain forest but are uncommon in ninebark chaparral. Although I have no quantitative data regarding these latter two divisions of the habitat, my opinion is that the species is less abundant in either of them than in the riparian hawthorn thickets which apparently form the optimum habitat for Traill's Flycatcher in the Palouse Hills.

*Chronology of the nesting seasons, 1952 and 1953.*—Figure 1 compares the 1952 and 1953 nesting seasons in terms of the incidence of fresh, complete clutches of eggs. Each curve is based upon 19 clutches. For a majority of the 1952 nests, and some of the 1953 nests, these dates for the complete, fresh clutches were obtained by a process of extrapolation based on the known or closely estimated age of the nest contents at some stage of their development. This method has previously been utilized by Lack (1950), Beecher (1942), and others in a similar manner. Errors inherent in the method arise from individual variation in the incubation and nestling spans and

from the fact that some birds apparently begin incubation following the laying of the second egg. Hence, some clutches designated as "fresh" may have had two eggs which had been, on the average, incubated for 24 hours. Taking into account all known sources of variation, the least reliable of my data are subject to a possible error of  $\pm 3.5$  days. Sixteen per cent of the 38 dates are thus affected, the remainder being subject to lesser possible errors down to a few hours. Statistically, one may expect these errors to tend to cancel one another except at the limits of the curves. Fortunately, the dates of earliest known incubation in both years have possible errors no greater than  $\pm 12$  hours. The incubation period in these calculations is taken to be 12 days (Burns, 1915; Bendire, 1895), and the nestling period to vary from 13 to 15 days (Burns, 1921; Berger and Hofslund, 1950).

Three major features are evident in comparing the chronologies of the nesting seasons of 1952 and 1953: (1) The close coincidence of the dates of earliest known incubation, (2) the protracted (by about 16 days) 1953 season, and (3) the lower and later (by about one week) peak of activity in 1953. The total span of the nesting season in 1952, considered as the interval between the laying of the earliest known egg and the fledging of the latest known young, was 46 days. In 1953 this span was 67 days.

*Nesting chronology in relation to phenology.*—It would be absurd to attempt to determine on the basis of the meager data available even the major environmental factors influencing the nesting periodicity of Traill's Flycatcher. However, certain observations regarding the possible relation of weather and of seasonal progress as reflected by plant phenology are suggestive; these are noted here for the consideration of other students of *Empidonax traillii*. A comparison of the weather in 1952 and 1953 is shown in Table 2. March of 1953 was warmer than that month of 1952, but the rest of the spring and early summer was considerably colder than in 1952. Vegetative growth, which in the principal species began prior to the temperature

TABLE 2  
COMPARATIVE WEATHER DATA, 1952-1953 (U.S.D.C., 1953)

	Precipitation		Mean Temperature	
	1952	1953	1952	1953
March	1.15"	1.74"	37.2 F.	40.4 F.
April	0.94	1.37	50.3	45.7
May	1.21	1.13	55.5	51.5
June	2.94	1.09	59.4	55.5
July	0.07	0.00	68.2	66.6

recession, followed similar patterns during the two years, and by mid-June vegetation density in Traill's Flycatcher habitat was apparently identical. Many of the May and June dates of first bloom, however, were much retarded in 1953 and reflected a general biological "lateness" of that year as compared with the preceding one (phenological dates were obtained by the method of the extensive survey, following principles established by Leopold and Jones [1947]). Seven shrubs and forbs for which I have extensive data for the two years bloomed later in 1953 by an average of 13 days; *i. e.*, *Rosa* spp., 14 days; *Crataegus douglasii*, 7 days; *Prunus virginiana* var. *melanocarpa*, 12 days; *Physocarpus malvaceus*, 15 days; *Lupinus sericeus*, 13 days; *Camassia quamash*, 8 days; *Iris missouriensis*, 15 days. This "lateness" was obviously shared at least in part by Traill's Flycatcher, as manifested by the later and lower peak of nesting activity and the protraction of the nesting span. In my opinion, this tardiness was not the result of any mechanical deficiency in nesting sites, as McCabe (in Leopold and Jones 1947: 108) has very reasonably suggested for *Empidonax traillii* in Wisconsin. The shape of the curve for 1953, in comparison with that of 1952, suggests a relatively large percentage of first-nest failures, but my data offer nothing to confirm this hypothesis. It is possible, also, that the considerably later blooming dates in 1953 had a significant quantitative effect on the periodicity of insects used as food for the nestlings of this species, as McCabe has previously postulated for Traill's Flycatcher in Wisconsin. Lack (1950) emphasizes the food supply for nestlings as a major "ultimate factor" (*i.e.*, one operating through natural selection to bring about a coincidence of breeding season and food supply for the young) modifying the breeding periodicity of birds of the North Temperate Zone in Europe.

Within the framework of seasonal retardation which has been discussed above, one factor stands out as anomalous; *viz.*, the close agreement of dates of earliest eggs in 1952 and 1953. This is all the more conspicuous because of the comparatively large average temperature differences occurring during the first fifteen days of June in those two years (59.6° F. in 1952, 55.0° F. in 1953), and because of the very heavy rainfall (230 per cent of average) during June of 1952, as compared with subnormal precipitation (82 per cent of average) in 1953. A detailed analysis of daily average, minimum, and maximum temperatures failed to reveal any pattern with which this temporal coincidence could be correlated. It is entirely possible that it is, in fact, a coincidence; but it would be inadvisable to ignore the possibility that it may also be a response principally to some

annually recurring change in environment, such as increasing photoperiod.

*A possible phenological indicator.*—Certain species of plants, as Leopold and Jones (1947: 113) point out, are governed principally by photoperiod in their annual growth cycles and show only small year-to-year differences in phenology. Such species in our area appear to be yarrow (*Achillea lanulosa*), with a date of earliest bloom two days later in 1953 than in 1952, and cow parsnip (*Heracleum lanatum*), which first bloomed three days later in 1953 than in the preceding year. This latter species is a conspicuous element in the streamside habitat of Traill's Flycatcher in the Palouse Hills, and an apparent correlation occurs between dates of its first bloom and of first eggs of the flycatcher. Both of these phenomena were three days later in 1953 than in 1952, with a lapse of 20 days between first observed bloom and first known egg. *Heracleum* has a continent-wide distribution, and comparative data from other areas would be very interesting.

*Incubation period.*—Little has been recorded on the incubation period of *Empidonax traillii*. Burns (1915), probably citing Bendire (1895), gives 12 days. Dawson and Bowles (1909: 389), perhaps using the same source, concur. Although individual variation among clutches and variations arising from environmental differences undoubtedly modify this datum, 12 days probably represent an average incubation period. Several clutches which I had marked for incubation studies were all lost to predators before hatching, and data obtained incidentally from other nests, although tending to confirm a 12-day period, do not improve what is already estimated.

*Growth of nestlings.*—Studies of four broods, one of them containing a nestling Brown-headed Cowbird (*Molothrus ater*), were begun in 1953. Only one of these broods was successfully fledged. Inasmuch as the parasitized brood was excluded in summarizing the growth data, the information presented below is based upon nine nestlings for the first three days of nestling life and for lesser numbers thereafter. (See table 3 and figure 2.) All weights were taken on a single-beam, agate-bearing balance accurate to 0.1 gm. Feather lengths were measured with a millimeter rule, interpolating to the nearest 0.2 mm. It was possible to visit each nest only once daily, for measuring purposes, between 6 P.M. and 7:30 P.M. The time of daily visits to individual nests varied within less than one-half hour. At no time, even late in nestling life, was any difficulty encountered with weighed birds not remaining on the nest when replaced there. This is in accord with the observation of Lack and Silva (1949: 64) that regular visits, begun at an early age, to broods of English Robins (*Erihacus*

*rubecula*) eliminated the escape reactions found in young of this species when first encountered at a later stage of nest life. In common with this species, *E. t. brewsteri*, if older than about seven days of age when first encountered, readily flees the nest.

An effort was made to visit the nests at least twice daily during the anticipated hatching period, but this was not always possible. When eggs were found in a nest on one day and nestlings on the following day, this latter day was designated as "day 0.5" of nestling life, after the method of Lack and Silva (1949), since, on the average, nestlings would be twelve hours old when found. Based on six estimated hatching times, my birds averaged about ten hours old when first examined. Days subsequent to the hatching date are designated 1.5, 2.5, and so on. As Lack and Silva (1949) note, this method is more accurate than denoting the first day as "day 0" or "day 1" and avoids the confusion inherent in these alternative notations.

*The newly hatched nestling.*—Weights of nestlings with some portion of the dorsal down still moist after hatching were 1.4, 1.4, 1.6, 1.0, and 0.9 gm. The last two weights are from a nest containing a nestling cowbird and are no doubt atypical. At this early age, and until about day 2.5, the nestling assumes an embryonic posture in the nest, resting on the huge abdomen and the crown of the turned-under head. At first, there is no gaping response to jiggling of the nest, but this appears within twelve hours after hatching. Copious, long Mouse Gray down (all capitalized color names after Ridgway, 1912) clothes the crown, and tufts of shorter down, Pallid Neutral Gray in color, occupy the spinal and alar tracts. The positions of the humeral, femoral, and crural tracts are indicated by three or four down feathers each, and about seven down feathers are present on each side in the abdominal portion of the ventral tract. The remigial papillae are visible through the skin of the wings as minute blue-black dots. Coloration of soft parts is as follows: *gape*, Cadmium Yellow, remaining this color throughout nestling life; *rictus*, Pinard Yellow, darkening slightly later; *rhamphotheca* and *podotheca* Orange-buff. By day 6.5 the thecae have altered to Ochraceous-buff and Apricot Yellow in blotches. At about twelve days, the *gonys* is near Flesh-color, the *culmen* Vinaceous Fawn, and the *tarsus* various tones near Light Purplish Vinaceous.

The only motor responses to handling during the first hours of nestling life (and up until about day 5.5) are a pedaling motion of the legs and a clasping and unclasping of the toes. The voice is a faint *weep-weep-weep*, uttered without opening the bill.

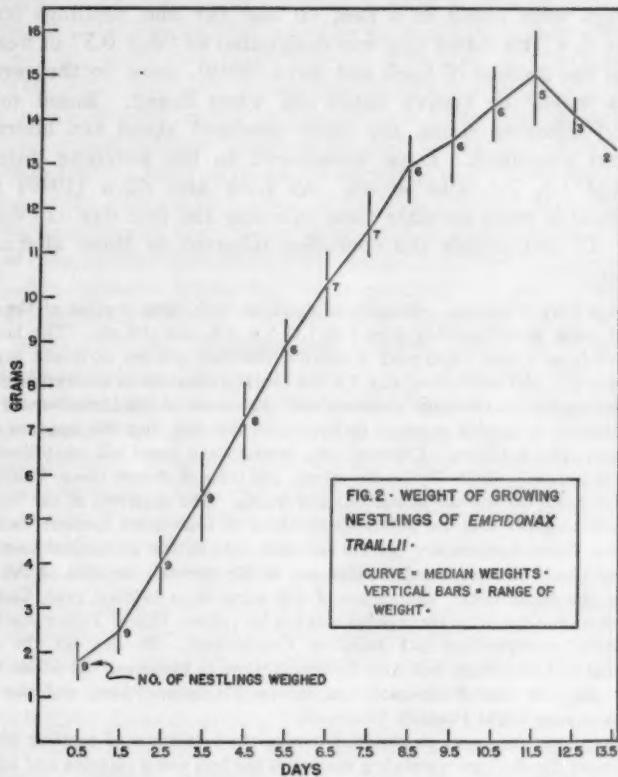
*Subsequent development of the nestlings: endysis.*—Feather development was very similar in nestlings of similar age, and the rate of growth appeared to be independent of weight variations in individual birds. It is, therefore, the best criterion of the age of the nestlings.

*Day 1.5.*—No conspicuous change from day 0.5; dark papillae of the contour feathers visible in the cervical region of the ventral tract in some birds.

*Day 2.5.*—Dark papillae visible in all tracts in which dark feathers are to appear. Papillae of the rectrices visible as a dark crescent. Sheaths of the secondaries either distending the skin of the wings (*i.e.*, "pointed"), or projecting less than 0.5 mm. through the skin.

*Day 3.5.*—Contour feathers of the pectoral region piercing skin of all nestlings. Sheaths of the spinal and humeral tracts beginning to pierce the skin, or at least pointed. Sheaths of the primaries either pointed or less than 1 mm. through the skin. Secondary sheaths elongating.

*Day 5.5.*—Pin-feather stage. Sheaths much elongated but rupturing only in the pectoral and abdominal regions. Sheaths of the rectrices less than 1 mm. through the skin. Median length of the tenth (outer) primary sheath 4.6 mm.



*Day 7.5.*—Vanes of most of the contour feathers well-expanded except in the frontal, gular, auricular, malar, and submalar regions. All, or nearly all, secondary vanes expanded 1 mm. or less. Sheaths of the first (inner) and second primaries may begin to rupture. Vanes of the inner rectrices expanded about 1 mm. Median length of the tenth primary sheath 10.4 mm.

*Day 8.5.*—The increasing exposed-vane surface gives the definitive coloration and pattern to the nestlings. All remigial sheaths now ruptured. Median length of the tenth primary sheath and vane 13.4 mm.

*Day 9.5.*—Wing-bars are well defined on the expanded vanes of the lesser coverts. Dorsal and lateral apteria covered by the converging contour feathers when the nestling is in repose. The ventral apterum still exposed.

*Day 10.5*.—Well-feathered except for frontal, auricular, gular, malar, and submalar areas, where sheaths are still prominent. Upper wing coverts cover or nearly cover the unruptured portion of the remigial sheaths, giving the wing an almost solid surface.

*Days 11.5 to 13.5*.—No conspicuous change in feathering. The ventral apterium is covered by the converging feathers of the ventral tract, and endysis is essentially complete in the head region by the time the young birds vacate the nest on about day 12.5.

*Growth of flight feathers*.—The tenth primary, of those flight feathers measured daily (*i.e.*, tenth, first primaries, outer rectrices), appears to be the only useful quantitative criterion of age (see table 3). The median growth rate of this feather in those birds measured was sufficiently rapid that the extremes of daily measurements do not overlap, although in some cases they closely approach one another. This was not true of the first primary or of the outer rectrices. No measurements of feather growth were made after day 11.5.

*Daily weights of the nestlings*.—The daily change in weight of the growing nestlings is shown in table 3 and figure 2. The statistical justification for using median rather than mean values for small samples is given by Dean and Dixon (1951) and will not be elaborated here. In any event, the means did not differ more than 0.3 gm. from the median values. It is readily seen, especially in figure 2, that the age

TABLE 3  
WEIGHTS AND FEATHER MEASUREMENTS OF NESTLING TRAILL'S FLYCATCHERS

Day of Life	Number of Birds	Median Weight	Range of Weight	Median Change in Weight	Length Tenth Primary
					Median Range
0.5	9	1.8 gm.	1.4-2.2 gm.	—	—
1.5	9	2.5	2.0-3.0	+0.7 gm.	—
2.5	9	4.0	3.3-4.6	1.5	—
3.5	9	5.5	4.5-6.5	1.5	1.0 mm. 0.6-1.4 mm.
4.5	8	7.2	6.3-8.1	1.7	+1.5 2.2 1.6-3.1
5.5	6	8.9	8.1-9.5	1.7	gm./day 4.6 3.4-6.0
6.5	7	10.3	9.6-11.0	1.4	7.4 6.2-8.2
7.5	7	11.5	10.9-12.4	1.2	10.4 9.2-11.4
8.5	6	12.9	12.1-13.6	1.4	13.4 12.6-14.4
9.5	6	13.5	12.6-14.5	0.6	16.2 15.0-17.4
10.5	6	14.3	13.5-15.2	0.8	+0.7 18.8 17.6-20.2
11.5	5	15.0	13.9-16.0	0.7	gm./day 21.8 21.6-22.2
12.5	3	14.1	13.7-14.5	-0.9	-0.85 NR* NR
13.5	2	13.3	13.2-13.3	-0.8	gm./day NR NR

\*No record

of nestling Traill's Flycatchers cannot safely be determined at any stage of growth on the basis of weight. With few exceptions, the extremes of successive statistical populations overlap. In a larger sample, overlap would probably prevail in all cases and to an even greater degree.

*Growth rate and motor coordination*.—Three rather distinct phases of median weight change may be seen in table 3. A minor break in the data, and curve, began at about six days, when the eyes of the nestlings were opening and the birds were beginning to acquire motor reactions more complex than the gaping and grasping responses which marked the first six days of nestling life. The first cowering response to my approach was seen on day 6.5, and the wings were first used in strong

fluttering motions on this day. A sharper break in the growth-rate curve occurred on day 8, when the growth of contour feathers was substantially ended and the nestlings were generally more active. By this time the birds were able to manipulate and fold their wings quite proficiently, whereas previously the wings had hung loosely at the sides. When removed from the nest, the young birds sat erectly on their tarsi, glancing about alertly. By day 10.5, the birds were able to perch erect on my finger and shortly thereafter were using their wings in attempted escape flights from the pan of the scale. The decline in weight after day 11.5 is probably correlated with the increased activity of the young in the nest. That this decline is not an isolated case in a single brood is shown by another brood (No. 53-22) which was weighed two days prior to departure from the nest, and again on the day of departure. The first weights were 14.6, 15.0, and 15.1 gms.; the later weights were 13.4, 13.6, and 13.7 gms. At the time of the last weighing, one bird was found perched near the nest, and the other two were frightened from it. Inasmuch as their ages were not accurately known, the data are not included in table 3 or figure 2.

With due regard to minor differences in time, the sequence of development in Traill's Flycatcher does not differ markedly from that outlined by Nice (1943: 73) for open-nesting passerine species in general.

*The egg tooth.*—This structure is visible throughout nestling life. Its white tip is apparent to the unaided eye until about day 4.5 or 5.5. Because of the heterogonic growth of the bill, it shifts from its initial position on the culmen until, at about twelve days, it appears as a minute tubercle on the hook of the bill. It has thus rotated through 90 degrees.

*The nestling period and nest departure.*—Burns (1921) gives the span of nestling life in *Empidonax traillii* as 13 to 14 days. Berger and Hofslund (1950: 9) report 14 and 15 days for the species in Michigan. In my nest number 53-17, in which the nestlings were handled daily, nestlings 1 and 2, which hatched on the same day, were in the nest 12 days,  $19.5 \pm 4$  hours. Nestling 3, which hatched a day later than its siblings, also left a day later, after 12 days,  $6 \pm 5$  hours in the nest. These nest departures were entirely voluntary, so far as is known, and occurred during my absence. It is of course entirely possible that my daily handling of the nestlings had some effect on their tenure in the nest. Nestlings 1 and 2 were found sitting on a branch 1.5 feet from the nest, having left it between dawn and 7:30 A.M. At 6:30 P.M. they were still in the nest tree, four feet away from the nest. The following morning they were about sixty-five feet away from the nest and across a small creek, and they were being fed by the adult flycatchers. At this time nestling 3 was found perched on the edge of the nest but crouched down in it at my approach. At about 6:30 P.M. of the same day it was still in the tree but flew out of it as I approached, alighting about forty-five feet away. It is evident that this species acquires some degree of proficiency in flying within a day after leaving the nest.

*Reproductive success.*—Of 33 clutches, 19 were of three eggs, and 14 were of four eggs. This ratio differs from the data of Berger and Hofslund (1950), who found nine clutches of three eggs and 14 clutches of four eggs in 23 nests in Michigan, and from Farley's (1901) report that clutches of four eggs are the more common in eastern Massachusetts. During the first year of the present study, 21 of 25 eggs hatched, a success of 84 per cent. In 1953, 42 of 43 eggs hatched, a success of 98 per cent. Berger and Hofslund (1950) report a hatching

success of 92 per cent for 36 Traill's Flycatcher eggs. I have no satisfactory data for fledging success in the Palouse Hills in 1952, but in 1953, it was 44.6 per cent (21 of 47 nestlings were successfully fledged). This is quite close to the average fledging success of 43.0 per cent which Nice's (1937: 143) compilation indicates is typical of passerine species which construct open nests.

Causes of nesting failure were known in only a few cases. Two nests contained one Brown-headed Cowbird egg each. One of these was abandoned by the flycatchers before incubation began, and the nestlings in the other nest, which hatched when the cowbird was about three days old, would not have survived, judging from their almost static daily weights, even if a predator had not taken them. Cattle trampled two nests, and Black-billed Magpies (*Pica pica*), attracted to the study area in rather large numbers by rodents killed in a nearby wheat fire, are suspected of having taken several sets of eggs. Only one case of malformation was observed in the 60 nestlings examined during the course of this study. This bird lacked the left one-half of the upper mandible from the nostril distad. It was as far advanced as its nest mates and resisted handling just as vigorously. A very dense population of the Northern Fowl Mite (*Bdellonyssus sylvarium* C. and F.) was found in one nest. A nestling about twelve days old was collected from this nest, and despite the heavy infestation of mites, the bird seemed healthy and was of normal weight.

**Voice.**—Two general song types are attributed to *Empidonax traillii* in the eastern and midwestern portions of its range; a bi-syllabic form usually transcribed as *fitz-bew*, and a tri-syllabic type designated by *way-be-o* or *phe-be'-o* (Aldrich, 1953; McCabe, 1951). Allen (1952), in commenting upon certain phonetic transcriptions of the songs, correctly points out that syllabification is the result of human interpretation and transcription of the component sounds of the song and that some hearers may regard as a discrete syllable what others interpret merely as an inflection. Nevertheless, experienced field observers are agreed that two different songs exist in eastern (three syllables) and midwestern (two syllables) populations, and their opinions have been confirmed to a certain extent by audiospectrography (Kellogg and Stein, 1953).

Table 4 summarizes some interpretations of calls appearing in western literature. Regrettably, only a few of these can be closely fixed with regard to locality. In preference to arranging these calls according to syllabification, they have been classed on the basis of their apparent resemblance to a *deer* or a *bew* sound. As will be pointed out below, these phonetic groupings are ones into which the extensively

recorded calls of *Empidonax traillii* in the Palouse Hills fall rather conveniently, if not naturally. Further, as Aldrich (1953: 9) suggests, the "quality" of the song, as well as syllabification, may be a profitable avenue of investigation in comparing racial affinities and differences. This paper attempts to emphasize the two phonetic and syllabic groupings, together with their "quality" as expressed in the phonetics and manner of delivery of the calls, which are rendered by birds in the Palouse Hills and perhaps in the western United States in general.

TABLE 4  
PHONETIC TRANSCRIPTIONS OF THE SONGS OF *Empidonax traillii* IN THE WEST

Song	Authority	Locality
<b>Based on deer sound</b>		
<i>Weeps-a-dee-ar</i>	Sumner and Dixon (1953)	Sierra Nevada
<i>Weep-a-de'-ar</i>	Peterson (1941)	Western U. S.
<i>Weeps-a-pi-de'ea</i>	Hoffmann (1927)	Pacific States
<i>Pree-pe-deer</i>	Cooke (in Bailey, 1915)	Western U. S.
<i>Pre-pe-dee'</i>	Howsley (in Bent, 1942)	Western Washington
<i>We're he're</i>	Taverner (1926)	Western Canada
<i>Pi-de'ea</i>	Hoffmann (1927)	Pacific States
<i>Week tsu weert!</i>	Jewett, et al. (1953)	Washington
<i>Reek rair!</i>	Jewett, et al. (1953)	Washington
<b>Based on bew sound</b>		
<i>Fitz-bew</i>	Peterson (1941)	Western U. S.
<i>Fits-be'-o</i>	Peterson (1941)	Western U. S.
<i>Fay-be'-o</i>	Peterson (1941)	Western U. S.
<i>Prets-kew!</i>	Jewett, et al. (1953)	Washington
<i>Whitch-koo whitchy-koo!</i>	Jewett, et al. (1953)	Washington
<i>Zwee'bew, zweet</i>	Dawson and Bowles (1909)	Washington
<i>Zwee'bew, zsweet</i>	Dawson (1923)	California
<b>Not classified</b>		
<i>Zwee'-beck</i>	Howsley (in Bent, 1942)	Western Washington
<i>Ezee-e-u'p</i>	Taverner (1926)	Western Canada
<i>Rryrnk!</i>	Jewett, et al. (1953)	Washington
<i>Preet!</i>	Jewett, et al. (1953)	Washington

In common with certain of its midwestern relatives, Traill's Flycatcher in the Palouse Hills sings a distinctly two-syllabled song, *during the nesting season*. This is quite recognizable as the *fitz-bew* type of authors but to my ear is phonetically best transcribed as *whitz'-bew*, delivered explosively. This call has minor variations described below. When Traill's Flycatchers first appear in the spring, however, they utter a distinctly three-syllabled call which I have repeatedly recorded as *whip'-a-deer* and *weeps'-a-deer*. This tri-syllabic call is heard concurrently with the *fitz-bew* type, but as the courting season wanes it is heard less and less frequently until (except under conditions described below) it gives way almost entirely to the bi-syllabic form. Although this call is delivered emphatically, it does not have the explosive vigor of the *whitz'-bew* call. Howsley (in Bent, 1942: 203)

also noted a seasonal difference in the song of Traill's Flycatcher in Washington, recording the early call as *pre-pe-dee'*, and the later one as *zwee'-beck*. Saunders (*in Aldrich, 1953: 8*) reports a similar seasonal change in syllabification in eastern populations of *Empidonax traillii*. It is remotely possible, of course, that the migrant members of a more northern population, to which a tri-syllabic call is peculiar, are responsible for an apparent seasonal song dimorphism. However, certain features of the quality and phonetics of the call and of its occurrence lead me to believe that this is not the case. First, the *whip'-a-deer* call is employed by birds in territorial dispute early in the season. On 15 June 1953, I observed three males contending for portions of a small willow thicket. Each of them used this call repeatedly and vigorously. It is extremely doubtful that birds at this late date and engaged in this activity would be migrants. Secondly, the *whip'-a-deer* call, and variants using the *deer* sound, may be heard throughout the nesting season. I have failed to detect the exact circumstances which induce the tri-syllabic call but have noticed that on the few occasions when a male was stimulated to vocalization by the presence of an observer at its nest, this was the call generally employed.

Calls recorded for the Palouse Hills' population of *Empidonax traillii* appear in table 5. In interpreting and transcribing these calls in the field, every effort was made to avoid classifying them into conventionalized forms.

TABLE 5  
PHONETIC TRANSCRIPTIONS OF THE SONGS OF TRAILL'S FLYCATCHER IN THE  
PALOUSE HILLS

<i>Basic Song or Call</i>	<i>Variations</i>
Based on <i>deer</i> sound	
1. <i>Whip'-a-deer</i>	1a. <i>Pi-dee'r</i>
2. <i>Whil'-spdeer</i>	2a. <i>Whil'-spdee</i>
3. <i>Whip's-deer</i>	
Based on <i>bew</i> sound	
4. <i>Whiz'-bew</i>	4a. <i>Wriz'-ew</i>
5. <i>Whrrit'-ew</i>	5a. <i>Whrrit</i>
6. <i>Whree'-ew</i>	6a. <i>Whree'-o</i>
Call notes	
7. <i>Whip!</i>	7a. <i>Wheel!</i>

To that end, daily records were kept separate and were not collated or reviewed until the song season ended. The transcriptions appearing in table 5 are in the same form that they were recorded in the field. Because of the situation at the Missouri Flat Creek study plot, where many of the records were obtained, it was possible to compare the

calls of birds in the creek bottom with those inhabiting hillside thickets some 150 to 300 yards distant, thus noting the effect of distance and possible differences in birds of those dissimilar habitats. Also, because of the relatively dense population of the species in the creek bottom, song variations of one sort could immediately be compared with those of another type, thus reducing to a minimum the variable of what may be called "auditory memory."

In table 5 it may be seen that a *whip* or *whitz* element, together with an accented first syllable, is the common denominator in all calls except 1a. Song 1 is the definitely tri-syllabic type heard frequently early in the season. The *pi-deer*' call (1a) is also most frequently heard early in the season. Songs 2, 2a, and 3 are intermediate in syllabification and emphatic quality. It is often impossible to assign a call to a distinctly bi- or tri-syllabic category. Songs 4, 4a, and 5 are based on the *bew* note and are characteristic of the twilight song periods. Call 5a has a burry, grating quality and is delivered with an abrupt upward inflection. It is apparently homologous with Hoffmann's (1927) *prrit*, the *rrrynk!* and *preet!* of Jewett, *et al.* (1953), and McCabe's *creet* note, but it lacks the clear tonal quality implied by these latter two transcriptions. It does not enter into any consistent song pattern. Song 6 is a type which is infrequently heard at twilight. Like the *whrrit* call, it has a grating quality, with the *-o* or *-ew* element muted. Calls 7 and 7a are typical call notes. It seems to be a case of individual variation whether the note is of a flat tone (7), or whether it has a certain musical quality (7a), but the emphatic *whip!* type is by all odds the more common.

In final analysis, all that can be determined regarding song types by these observations is that: 1) The tri-syllabic *whip'-a-deer* call is confined chiefly to the pre-nesting season, 2) the *deer* element of the early song is present in several variations throughout the breeding season, and, 3) the calls given during the twilight song periods are based principally, if not exclusively, on the *bew* sound. It should be noted, however, that the *whit'-spdeer* type is also occasionally heard during the "tuning-up" phase which typically precedes the evening song period proper. A typical series, recorded on 18 July 1953, was: *whit!*, *whit!*, *whit!*, *whit'-spdeer*, *whit'-spdee* (pause) *whit!*, *whit!*, *whitz'-bew*, *whrrit!*, *whitz'-bew!* It remains to be demonstrated what correlation, if any, exists between song-type and the chronology of the breeding season. To this end, it would be interesting to have additional and more detailed information from other western populations of *Empidonax traillii*.

*Song periodicity and song perches.*—Traill's Flycatcher is already

in song when it arrives in the Palouse country in late May or early June. During 1953, regular evening song periods continued until the first week of August, when the theretofore well-defined song periods became sporadic. They ceased entirely on about 10 August, after which no birds were heard in regular twilight song, even though a few pairs still were attending young in the nest. Because of limited time afield, I have little data on diurnal song periodicity. However, some of it is interesting for comparative purposes. On 4, 5, and 6 July, morning song began abruptly at about 3 A.M. (P.S.T.). Traill's Flycatcher was the earliest species heard in the morning and was joined after a few minutes by the Western Flycatcher (*Empidonax difficilis*) and the Willow Thrush (*Hylocichla fuscescens*). Aside from an abrupt beginning, the morning song period was ill-defined, continuing intermittently until about 9:30 A.M. Comparatively few Traill's Flycatchers are heard during midday except in infrequent territorial disputes.

The limits of the evening song period are quite sharp, and except for a few individuals which call "prematurely," the birds of a given area begin and stop singing almost in unison. In common with McCabe (1951), I experienced little difficulty in assigning definite limits to the evening song period. On 25, 27, 30 July, and 2 August, the duration of this period was, respectively, 31, 33, 65, and 31 minutes. The weather was clear and warm on all of these days, and there is no readily apparent reason for the prolonged period on 30 July. Except for 25 July, when the evening song period extended 15 minutes beyond the end of civil twilight, the cessation of song fell within three minutes of the end of civil twilight. This is quite at variance with McCabe's (1951) much more extensive data, which indicate the evening song period consistently extends farther beyond twilight in Wisconsin.

The principal song perches of the males during the twilight period are the bare twigs at the tops of a hawthorn or chokecherry bushes, 12 feet to 30 feet above the ground, or, in the more barren uplands, on a telephone wire. During the "tune-up" period previously mentioned, the males flit from perch to perch, often feeding en route, building up to the crescendo of *whizz'-bew* calls which characterizes the twilight period, until they have attained an exposed site, which is frequently the highest bare twig in their territory. As a rule, they do not move from this site, except to snap up a passing insect, for the duration of the song period, although they occasionally move to a similar nearby perch. I have not witnessed the "song-flight" described by McCabe (1951), but this does not preclude the possi-

bility of its occurrence. From the best available vantage point I was able to observe only two singing birds at one time. Calls per minute, timed for three different males over 18 consecutive minutes at the height of the twilight song period, averaged 12.7. This included only distinct *whitz'-bew* calls and not the almost incessant *whit* and *whrrit* notes which accompany them.

*Behavior of the Adults.*—In contrast to many reports, I have not found Traill's Flycatcher in the Palouse Hills to be excessively shy in the presence of humans *except* after the nesting season is completed and territories have been abandoned. During this period they are rather furtive, and it is necessary to "call them in" by making squeaking sounds with the lips. To this artifice they usually respond only once. During the spring and the nesting season, however, feeding birds take no heed of the observer until he is within about thirty feet of them. Even then they rarely seek refuge but are as likely to move further away and continue feeding. Very much in contrast to what is said of eastern populations (Farley, 1901: 354; Bent, 1942: 209), *E. t. brewsteri* is a quite close sitter. Indeed, one of the more profitable means of locating nests is to agitate the brush and watch for a departing female. The behavior of the adults when an observer is at the nest varies widely with individual pairs and has no evident correlation with the chronology of the reproductive season. Some females, after flushing, are not seen or heard again; others skulk in the brush nearby uttering their *whit* or *wheet* note. Still others flush from the nest to an exposed perch where they sit, *whit*-ing constantly. A few females are particularly aggressive and fly at the intruder vigorously snapping their beaks, *whit*-ing furiously, and flitting back and forth near the nest in great agitation. Occasionally, a male will become infected with the excitement of its mate and accompany her to the nest, calling *whitz'-spdee*.

In its feeding habits, Traill's Flycatcher is quite conspicuous, and the birds seek an exposed perch from about one foot to about eight feet above the ground. Singing males frequently feed from their song posts, but at other times during the diurnal cycle they are not often observed above the heights indicated. Although perch predilection is no doubt determined to a certain extent by the height at which flying insects are most abundant, typical feeding perches are seen to be the strands of fences, a bare twig overhanging a steep-cut creek bank, or one of the many dead branch-ends provided by the peripheral foliage of the hawthorn. Occasionally, a Traill's Flycatcher may be observed feeding along the edge of a wheatfield, flitting rapidly from spike to spike or darting out almost at ground

level over an open meadow, pausing momentarily on slender herbaceous stems.

#### SUMMARY

The area in which Traill's Flycatcher was studied lies in south-eastern Washington in the broad ecotone between the Palouse grassland and the conifer forest of the northern Rocky Mountains. The aboriginal vegetation of this area has been greatly reduced by agriculture, and the habitat of Traill's Flycatcher is now confined to narrow streamside thickets, restricted upland prairie remnants, and the brushlands fringing coniferous forest.

In the Palouse Hills, Traill's Flycatcher occurs both in relatively mesic riparian thickets and dry upland brush patches. This habitat distribution is similar to that reported for *Empidonax traillii* in the East and Midwest but differs from the majority of reports from the West, which strongly emphasize an affinity for dense cover and moist areas.

Certain factors apparently important in determining the habitat distribution of Traill's Flycatcher in the Palouse Hills are discussed.

The site and structure of 42 Traill's Flycatcher nests are analyzed. Yellow Warbler-like nests and Song Sparrow-like nests form the extremes of a series which includes intermediate types.

The chronologies of the nesting seasons of 1952 and 1953 are discussed in relation to plant phenology and other factors.

The growth of four broods of Traill's Flycatchers is analyzed in terms of weight, endysis, and behavioral development. Of those measurements taken, the length of the tenth primary proved to be the only single reliable criterion of the age of the nestlings.

Hatching success during 1952 was 84 per cent. During 1953, it was 98 per cent. Fledging success during 1953 was 44.6 per cent.

The voice of Traill's Flycatcher in the Palouse Hills is compared with phonetic transcriptions appearing in the literature. During the courting season in this area, a three-syllabled song predominates, giving way in the nesting season to a two-syllabled song. The songs and their variations fall rather naturally into two groups: those including a *bew* note and those including a *deer* note. The call notes comprise a third group.

Traill's Flycatcher was found to be a rather close sitter at the nest, and often an aggressive defender of it; but this latter behavior varied greatly with individual females.

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*Department of Zoölogy, State College of Washington, Pullman, Washington, 15 March 1954.*

FURTHER NOTES ON BIRDS OF THE  
LAKE PATZCUARO REGION, MEXICO

BY ERNEST P. EDWARDS AND PAUL S. MARTIN

THIS paper, a supplement to one published by Lea and Edwards (1950) deals primarily with additional information on ecology and distribution. Periods of study were February 18 to March 27, 1948, May 19 to June 9, 1948, and August 26 to 30, 1950. From February 18 to March 27, 1948, the writers were assisted by Roger Hurd; from May 19 to June 8, 1948, they were alone; from August 26 to 30, 1950, Edwards was assisted by Robert B. Lea, Virginia L. Lea, Douglas Lancaster, and Shirley Windnagle, in the absence of Martin.

Four localities not mentioned in the previous report were investigated. The first of these was an old lava flow, at the southwest corner of the lake. The jumbled rocks were still sharp-edged and jagged, and there was no topsoil except in a few of the low places in the flow. The vegetation was sparse, consisting mostly of *Opuntia*, *Rhus toxicodendron*, and a few thorny shrubs. Among the birds, four species were of particular interest. *Chordeiles acutipennis* was present in the spring, single individuals occasionally being flushed from between the rocks. Males of *Eugenes fulgens* were extremely pugnacious there in March, and we often saw a dozen or more in a morning, fighting among themselves. *Contopus virens* apparently was absent in early spring but was common and in breeding condition in late May and June. We occasionally noted one or two *Melanotis caerulescens*.

The second additional locality included the lower slopes of Cerro Ihuátzio on the east side of the lake about 11 kilometers north of the town of Pátzcuaro. The land was deeply cut by erosion, and between the big, rocky gullies only a sparse covering of grass, acacia-like legumes, and a few pines persisted. As was the case at the old lava flow, *Contopus virens* and *Melanotis caerulescens* were breeding there in small numbers. *Camptostoma imberbe* was common in this rather open country. Specimens of *Empidonax albicularis* were unexpectedly taken on the dry hillsides as well as in the willow-grown marsh along the south shore of the lake, and the striking habitat difference was reflected in the great disparity in amount of plumage wear. The marsh birds were fresh and clean in late May and June, while the birds of the open hillsides were very badly worn. The co-types of *Empidonax albicularis axillaris* are much worn while others in a series at the U. S. National Museum, taken at comparable dates, show the same segregation into fresh and worn birds. *Campylorhyn-*

*chus gularis* was a common breeding species in the open country. One nest containing five young was a hollow football-shaped bundle of plant fibers wedged between the stems of an *Opuntia*. We noted an adult female eating a small lizard (*Anolis*), only one end of which could be accommodated by the gizzard, the tail hanging out of the bird's mouth. A rather surprising find in the open country was a nest of *Colaptes cafer* about six feet above ground in the flower stalk of an *Agave*. During the breeding season *Tanagra musica* inhabited the sparsely covered hillsides and probably nested there, but winter flocks were found around forest edges at higher elevation.

The third locality was a long, narrow belt of open pine woodland extending parallel to the highway to Tacámbaro, approximately ten kilometers south of Pátzcuaro. It was a relatively pure stand of pine, with oak trees only along the few gullies which cut through the woodland. A nest of *Sialia mexicana* was situated at the edge of this woodland and was attended by three adults, two males and a female. A female *Loxia curvirostra* taken in the pine woods on February 25 had an enlarged oviduct and well-developed brood patch, while a female *Oriturus superciliosus* taken there on August 30 had ova up to 22 mm. in diameter in the ovary.

The fourth was a rather dry pine and oak woodland with considerable *Arbutus xalapensis* and much undergrowth covering a hillside at the north end of the lake, approximately 11 kilometers west of Quiroga along the highway to Guadalajara. On the west it merged into pure oak woodland and on the north into almost pure pine. The most noteworthy breeding birds in this woodland were *Accipiter cooperii*, *Trogon elegans*, and *Vireo gilvus*. A female *Accipiter cooperii* stooped repeatedly at Edwards on two days in late May and June, and upon being collected proved to have a large brood patch. A few moments after this one was shot, another individual carrying a small mammal flew overhead cackling. A pair of *Accipiter striatus* was seen in the woodland and probably was nesting there.

A nest of *Trogon elegans* was found in a tree-hole which had previously been occupied by an *Otus*, probably *trichopsis*, which was abundant there. The local distribution of *Trogon elegans* was somewhat puzzling. It seemed to completely replace *Trogon mexicanus* in the dry pine-oak woods north of the lake but was absent in the humid pine-oak woods and fir forest, where *Trogon mexicanus* was common.

A nest of *Empidonax difficilis* on a rock ledge in a deep ravine contained two eggs on June 4. We discovered two nests of *Vireo gilvus*, by tracing the males which were singing on the nests. The

nests were composed of a golden-brown downy plant material and were placed 15 and 25 feet above ground, respectively, in *Quercus* and *Arbutus* trees. Transients were abundant in February and March but few individuals bred there.

We found no nests of *Lepidocolaptes leucogaster*, but it was abundant in the dry pine-oak woodland. *Parus wollweberi* and *Melanotis caerulescens* were present in small numbers in May and June, while *Zenaida asiatica* appeared along the woods edge at that time.

South of Pátzcuaro the humid pine-oak woodlands and the fir forest, both studied intensively in previous years, yielded additional items of interest.

*Dendrocytus macroura* was found to occur in both places, usually in pairs, which when surprised would stand motionless a moment before running off through the undergrowth. Its call, heard near dusk in the fir forest, was a clear four-noted whistle, the last three notes sounding much like the call of *Caprimulgus vociferus*.

Another species which was common in both the humid pine-oak woodland and the fir forest was *Campylorhynchus megalopterus*. On May 25 a group was observed constructing what appeared to be a communal nest on a horizontal branch of a fir. The nest, composed of twigs, was approximately 14 inches in diameter and appeared to be open-topped. Two birds were seen carrying sticks to the nest, and at least two other individuals came to the nest to rearrange nesting material. The group of about ten birds remained near the nest for an hour. On one occasion two of them fought, fluttering down to the ground together. On June 2 no activity was noted at the nest.

*Eugenes fulgens* was abundant in the humid pine-oak woods in August, in contrast to its very small numbers there during the rest of the year. *Turdus assimilis* and *Vireolanius melitophrys* were seen there in late spring for the first time. The only individual of the former species noted was singing persistently. Edwards twice had opportunity to watch *Vireolanius* singing in the treetops. It did not move about as it voiced its "whip, whee-oo," the first syllable soft and rasping, and the last two similar to the call of a nearby *Myiarchus tuberculifer*.

In the fir forest one individual each of *Platyparis aglaiae* (March 5) and *Diglossa baritula* (August 30) was seen and collected.

Considerable emphasis was placed on determining the status of wintering waterfowl. We made two complete circuits of the lake in a motor launch, the first on March 17 and the second on May 31. We traversed portions of the lake also on March 9, 13, and 16. By late May the numbers of ducks had dwindled considerably from the

winter peak, but even as late as the first few days of June flocks of 100 or more of some species were still in evidence, and *Anas clypeata* was more abundant than before.

*Fulica americana* was considerably more abundant and widespread than any other species of waterfowl on the lake, reaching a peak of 1800 individuals in mid-March and dwindling to about 350 in late May.

In March *Anas cyanoptera* and *Mareca americana* appeared to be most abundant of the ducks, the counts reaching approximately 500 individuals each. Somewhat less abundant, in order, were *Aythya affinis*, *Anas acuta*, *Bucephala albeola*, and *Oxyura jamaicensis*, the last two species numbering approximately 100 each. *Anas discors*, *Anas crecca*, *Chaulelasimus streperus*, and *Aythya americana* were represented by less than ten individuals each at that time. Most of the species common in March dwindled sharply in numbers in late spring, but the count of *Chaulelasimus streperus* rose to more than 600 at the end of May, *Oxyura jamaicensis* remained at about 100 individuals, and by the end of the first week in June *Anas clypeata* had moved into the lake in numbers of more than 100. *Podilymbus podiceps* was present in small numbers throughout the winter and spring, and two males taken in June seemed to be in breeding condition.

Other noteworthy species observed at the lake were *Pelecanus erythrorhynchus*, *Phalacrocorax olivaceus*, *Botaurus lentiginosus*, and *Florida caerulea*, the last a first record for Michoacán. A pair of *Nycticorax nycticorax* was nesting in a willow on the south shore of the lake.

The big marsh at the southeast arm of the lake was a scene of much activity in late May and June, with many breeding birds moving in, and still some transients such as *Geothlypis trichas chryseola* passing through. *Cistothorus platensis* proved to be a fairly common breeding bird, and specimens taken appeared to be *C. p. tinnulus* (Moore), formerly known from only one specimen. *Geothlypis speciosa* was breeding there in abundance in late May. By the end of the first week in June males of *Chamaethlypis poliocephala* and *Agelaius phoeniceus* had arrived and commenced to set up territories. At the same time in the fields bordering the marsh *Sturnella magna* was nesting and *Aimophila botterii* was singing persistently on territory.

#### LITERATURE CITED

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MOORE, R. T. 1940. Notes on Middle American *Empidonaces*. *Auk*, 57: 349-389.

## SPECIMENS COLLECTED

<i>Podilymbus podiceps</i> <i>podiceps</i> .....	2	<i>Empidonax difficilis</i> <i>occidentalis</i> .....	2
<i>Phalacrocorax olivaceus</i> <i>mexicanus</i> .....	1	<i>Empidonax albicularis</i> <i>axillaris</i> .....	4
<i>Botaurus lentiginosus</i> <i>lentiginosus</i> .....	1	<i>Camptostoma imberbe</i> .....	2
<i>Anas cyanoptera</i> <i>cyanoptera</i> .....	3	<i>Petrochelidon pyrrhonota</i> <i>melanogaster</i> .....	3
<i>Anas discors</i> .....	1	<i>Hirundo rustica</i> <i>erythrogaster</i> .....	6
<i>Anas crecca</i> <i>carolinensis</i> .....	2	<i>Aphelocoma ultramarina</i> <i>ultramarina</i> .....	2
<i>Anas acuta</i> .....	2	<i>Parus wollweberi</i> .....	2
<i>Mareca americana</i> .....	2	<i>Sitta carolinensis</i> <i>mexicana</i> .....	2
<i>Chenieramus streperus</i> .....	2	<i>Cistothorus platensis</i> <i>linnulatus</i> .....	3
<i>Aythya valisineria</i> .....	2	<i>Campylorhynchus megalopterus</i> .....	
<i>Aythya americana</i> .....	1	<i>megalopterus</i> .....	11
<i>Aythya affinis</i> .....	1	<i>Campylorhynchus gularis</i> .....	5
* <i>Bucephala albeola</i> .....	1	<i>Troglodytes aedon</i> <i>parkmani</i> .....	1
<i>Oxyura jamaicensis</i> <i>rubida</i> .....	1	<i>Troglodytes brunneicollis</i> <i>culequita</i> .....	1
* <i>Accipiter cooperii</i> <i>mexicanus</i> .....	1	<i>Troglodytes brunneicollis</i> <i>colima</i> .....	4
<i>Accipiter striatus</i> <i>suttoni</i> .....	1	<i>Melanotis caerulescens</i> <i>effuticus</i> .....	2
<i>Buteo jamaicensis</i> <i>calurus</i> .....	1	<i>Turdus assimilis</i> <i>renomina</i> .....	1
<i>Falco sparverius</i> <i>sparverius</i> .....	2	<i>Myadestes obscurus</i> <i>occidentalis</i> .....	5
<i>Dendrocytus macrourus</i> <i>striatus</i> .....	1	<i>Hylocichla guttata</i> <i>auduboni</i> .....	2
<i>Fulica americana</i> <i>americana</i> .....	1	<i>Sialia mexicana</i> <i>australis</i> .....	5
* <i>Capella gallinago</i> <i>delicata</i> .....	1	<i>Regulus calendula</i> <i>calendula</i> .....	1
<i>Erolia minutilla</i> .....	4	<i>Vireolanius melitophrys</i> .....	2
<i>Himantopus mexicanus</i> .....	1	<i>Vireo gilvus</i> <i>brewsteri</i> .....	2
<i>Larus delawarensis</i> .....	1	<i>Diglossa baritula</i> <i>baritula</i> .....	1
<i>Zenaidura macroura</i> <i>marginella</i> .....	1	<i>Vermivora ruficapilla</i> <i>ridgwayi</i> .....	1
<i>Geococcyx californianus</i> .....	1	* <i>Dendroica townsendi</i> .....	3
<i>Otus trichopsis</i> <i>trichopsis</i> .....	5	<i>Dendroica occidentalis</i> .....	5
<i>Chordeiles acutipennis</i> <i>texensis</i> .....	1	<i>Dendroica graciae</i> <i>graciae</i> .....	1
<i>Caprimulgus vociferus</i> <i>oaxacae</i> .....	2	<i>Oporornis tolmiei</i> .....	2
<i>Colibri thalassinus</i> <i>thalassinus</i> .....	4	<i>Geothlypis trichas</i> <i>chrysolela</i> .....	1
<i>Amazilia beryllina</i> <i>viola</i> .....	2	<i>Geothlypis speciosa</i> .....	8
<i>Eugenes fulgens</i> <i>fulgens</i> .....	3	<i>Cardellina rubrifrons</i> .....	3
<i>Archilochus colubris</i> .....	1	<i>Setophaga picta</i> <i>picta</i> .....	2
<i>Selasphorus rufus</i> .....	1	<i>Cassidix mexicanus</i> <i>mexicanus</i> .....	1
<i>Trogon elegans</i> <i>ambiguus</i> .....	1	* <i>Euphagus cyanocephalus</i> .....	1
<i>Colaptes cafer</i> <i>mexicanus</i> .....	3	<i>Icterus bullockii</i> <i>bullockii</i> .....	4
<i>Melanerpes formicivorus</i> <i>formicivorus</i> .....	2	<i>Icterus bullockii</i> <i>parvus</i> .....	1
<i>Sphyrapicus varius</i> <i>varius</i> .....	2	<i>Icterus wagleri</i> <i>wagleri</i> .....	1
* <i>Sphyrapicus thyroideus</i> <i>nataliae</i> .....	1	<i>Icterus cucullatus</i> <i>cucullatus</i> .....	1
<i>Dendrocopos villosus</i> <i>jardinii</i> .....	3	<i>Agelaius phoeniceus</i> <i>gubernator</i> .....	8
<i>Dendrocopos scalaris</i> <i>centrophilus</i> .....	3	<i>Sturnella magna</i> <i>europaea</i> .....	2
<i>Lepidocolaptes leucogaster</i> <i>leucogaster</i> .....	6	<i>Tanagra musica</i> <i>elegantissima</i> .....	3
* <i>Platysparis aglaiae</i> <i>albiventris</i> .....	1	<i>Tanagra musica</i> <i>rileyi</i> .....	2
<i>Sayornis nigricans</i> <i>nigricans</i> .....	1	<i>Carpodacus mexicanus</i> <i>centralis</i> .....	6
<i>Pyrocephalus rubineus</i> <i>mexicanus</i> .....	1	<i>Loxia curvirostra</i> <i>stricklandi</i> .....	2
<i>Myiarchus nuttingi</i> <i>inquietus</i> .....	2	<i>Oriurus superciliosus</i> <i>superciliosus</i> .....	6
<i>Contopus virens</i> <i>placens</i> .....	2	* <i>Ammodramus savannarum</i> <i>perpallidus</i> .....	1
<i>Contopus pertinax</i> <i>pallidiventris</i> .....	1	<i>Aimophila ruficeps</i> <i>fusca</i> .....	6
<i>Contopus pertinax</i> <i>pertinax</i> .....	2	* <i>Aimophila botterii</i> <i>botterii</i> .....	2
<i>Empidonax minimus</i> .....	1	<i>Junco phaeonotus</i> <i>australis</i> .....	3
<i>Empidonax hammondi</i> .....	1	* <i>Spizella atrogularis</i> <i>atrogularis</i> .....	1
<i>Empidonax wrightii</i> .....	1	<i>Zonotrichia leucophrys</i> <i>leucophrys</i> .....	1
<i>Empidonax affinis</i> <i>pulverius</i> .....	1		

\* First state records for Michoacán.

Box 611, Amherst, Virginia, and Museum of Zoology, University of Michigan, Ann Arbor, Michigan, March 20, 1954.

## IN MEMORIAM: FRANCIS HENRY ALLEN

BY WENDELL TABER

FRANCIS HENRY ALLEN, a Fellow of the American Ornithologists' Union, died at his home on 9 Francis Avenue, Cambridge, Massachusetts, on October 24, 1953, while the Annual Meeting of that organization was in progress in Los Angeles. Born on August 3, 1866, in Jamaica Plain, now part of Boston, the son of Henry Clay Allen and Emma Frances Briggs Allen, he attended the famous Roxbury Latin School, graduating in 1884. He received five honors in his entrance examinations for Harvard College. Financial necessity, however, compelled him to enter the business world where, over the years, he continued to acquire an education far superior to that of the average college graduate. He shortly became associated with the publishing firm of Houghton, Mifflin and Co., now Houghton Mifflin Co., Inc. By 1894 he was on the editorial staff, and an Editor he continued to be until his retirement from that well known Boston firm in 1934. The nature of his work aided him in becoming familiar with the various standard masterpieces of literature, and a retentive memory, which he retained to the end, enabled him to quote from them at will.

His first major work was the compilation in 1897 of "Nature's Diary." In 1916, he edited John Muir's "Stickeen," in 1927 the four volumes of "The Letters of Robert Burns," and in 1931 "A Boston Portrait-Painter Visits Italy—The Journal of Amasa Hewins (1803-33)." Particularly appealing to him, though, were the rugged individuality, the arresting style, and the challenging philosophy of Thoreau. Allen became an authority on this writer. This quickly became apparent in the joint editorship with Bradford Torrey in 1906 of the 14 volumes of "The Journal of Henry David Thoreau." Continuing alone Allen compiled in 1908 "A Bibliography of Henry David Thoreau" and in 1910 "Notes on New England Birds from the journal of Henry D. Thoreau," and also "Thoreau's Walden." More recently, in 1936, Allen edited "Men of Concord, as Portrayed in the Journal of Henry D. Thoreau." Interestingly, Thoreau's rather primitive knowledge of birds did not seem to disturb Allen.

On October 16, 1895, he married Margaret Hewins, who probably played a far greater part than one can now record in the success of her husband. She died on Christmas Day, 1947, after an illness of several years. During this protracted period she failed much of the time even to recognize her husband. His devotion and uncomplaining acceptance of a great trial set a standard for us all. Through-

out most, if not all their married life, the Allens lived at 215 La Grange Street in West Roxbury, now also a part of Boston, a location from which access to his childhood haunts was easily and frequently maintained. After his wife's death, with residential development pushing in and his own movements restricted by heart complications he moved to Cambridge, Massachusetts, where he shared a home first with his daughter, Lucy, and later with his oldest daughter, Elizabeth M. Allen (Mrs. William H. Thompson) and her family. Yet another two children, a son and daughter, also survive. Although not a member of any church he had been a pew-holder in and attended the Episcopal churches in West Roxbury and Dedham all his married life.

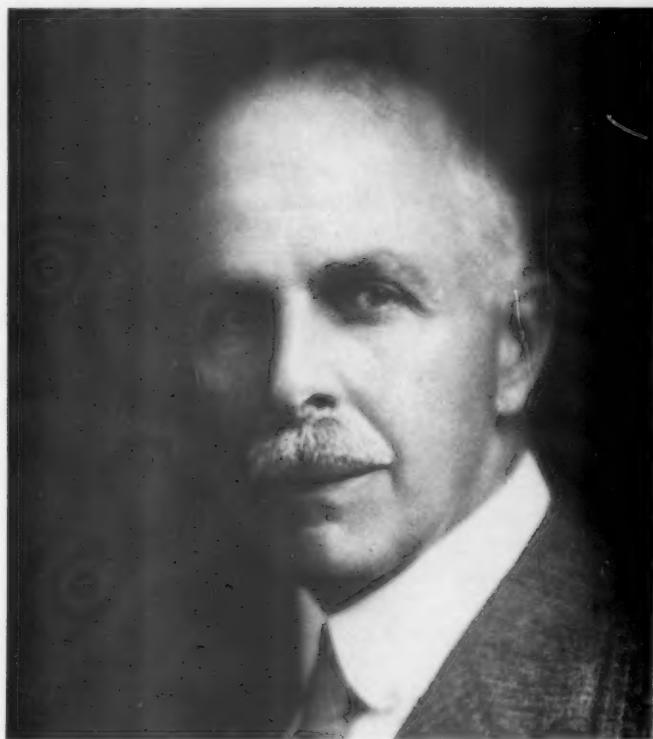
Of no known relationship to any of the other Allens of ornithological fame, Francis Henry Allen came directly from old Puritan stock on his father's side. His mother's ancestry included names historical in the colonial history of Massachusetts—Alden, Brewster, and Warren among others. A great-grandfather served as captain on General Washington's staff. While Allen's parents did enjoy an out-of-doors life, knew their local flowers, and introduced them to him in his early youth, there seems no evident explanation for his subsequent development.

In school, Allen was always, according to a schoolmate, well prepared in his lessons. In those days West Roxbury, to which his family had moved in his early childhood, was barely beginning the transition from farming country to suburb. Within easy access were great tracts of field and woodland and the meandering Charles River which, after wandering some five or six miles, returned to within not much over a half-mile of itself. Even today one can visualize from the marshes and other lands reserved for the Newton Water Works, and from the marshes and lowlands near Dedham, the ornithological appeal which must have existed in Allen's youth as he explored the then wild, charming and varied waterways, by canoe in summer—skates in winter.

On many of his boyhood trips he had the companionship of a cousin and another boy. A gift of eggs from one of the boys initiated the amassing of a youthful, but excellent, egg collection. He soon abandoned this field. He skinned a few birds but his first effort, a Myrtle Warbler, proved the best and he soon lost interest. He never became a real collector of specimens. Rather, the approach came through observations or thoughts which aroused his intellectual curiosity. He would acquire facts, ponder on them, turn them over and over in his mind, discuss them with other persons—then publish.

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PLATE 11



FRANCIS HENRY ALLEN



The sloppy inexactness of some of our more gorgeous and glamorous contemporary writers of nature articles was anathema to his truth-loving mind. At an early stage his unusually acute hearing and retentive memory for sounds led him into taking particular interest in bird-songs and call-notes. His forte in these two important fields appears at its best in the numerous comments scattered throughout Bent's "Life Histories of North American Birds." Bent was unsuccessful, however, in attempts to persuade him to write even one Life History. The assembling and consolidation of the investigations of other ornithologists offered less appeal than the pursuit of his own researches, a somewhat curious contrast with the intensity with which he had delved into the life of Thoreau.

Consistent with his business training he established for himself the standard of attempting to obtain the *ultimo*, first in the recording of accurate field observations, then—of more importance than is indicated in much of the writing today—in the presentation of his notes in perfect English. He even published a short paper on the importance in scientific papers of this presentation. He has said that he was always looked on a little askance by ornithologists on account of his literary leanings, and by literary persons on account of his predilection for the hard facts of science. Even during the last week of his life, still pleasant and interesting with his friends in spite of his weakness, he frequently called attention to errors of fact or expression in a book one of his daughters was reading aloud.

In the field he enjoyed the more old-fashioned approach of walking and studying a limited area rather than dashing hither and yon in an attempt to amass a record list of species. For many years he accompanied Dr. Winsor M. Tyler and Laurence B. Fletcher tabulating a Christmas Census of the south shore region of Boston near Cohasset, an area not popular among the great group of younger field observers. Another favorite annual spring trip, in which A. C. Bent also participated for many years, was a census of Osprey nests in southeastern Massachusetts and the adjoining Rhode Island territory. He looked forward, too, to numerous visits to the summer home of Dr. C. W. Townsend in Ipswich and the ensuing long walks on the beach. Accompanied by Dr. Townsend's young son, they traversed a large portion of the "Long Trail" over the Green Mountains of Vermont in 1917. At one time or another Allen climbed widely throughout the White Mountains of New Hampshire, and Katahdin in Maine. He also made a number of coastal trips in that latter state, and in 1929 visited Grand Manan. On field trips as well as at other times he was personally meticulous and well dressed. Of handsome mien,

slender in form and graceful in movement, and possessing a low voice with a contagious chuckle of appreciation, he made an entertaining companion.

In 1888 he became an Associate Member of the "A.O.U." He was elected a "Member" (now "Elective Member") in 1901 and a Fellow in 1947. As a quiet young man, almost too modest, he was elected to membership in the Nuttall Ornithological Club in Cambridge, Massachusetts, on December 18, 1893. Within a few months he introduced there a new subject of study—the waking hours of the earlier birds. He quickly aroused a broad interest, even among those members whose own habits made them only too willing to accept the facts at second hand. His regular attendance at meetings, his many interesting papers and careful field notes, his self-sacrificing services as Secretary, as Councillor, and for many long years as a most gracious and efficient Vice President have afforded an example without parallel in that Club. He withdrew from active official capacity in 1939 after forty-five continuous years of leadership worthy of the two presidents under whom he served, William Brewster and Glover Morrill Allen. Following a happy custom in the Club a celebration was held at a later date in honor of his 50 years of membership. His services in the leadership of the Club commenced on December 3, 1894, when he became a Member of the Council. There followed, commencing a year later, a year as Secretary, another 17 months as Councillor, and the Vice Presidency from May, 1898 until December, 1912. After 14 more years on the Council he added another 13 years as Vice President. As was quite natural he became a frequent dinner guest of Mr. and Mrs. Charles Foster Batchelder before Club meetings which, after William Brewster's death, were held for many years at the Batchelders' home.

Even more impressive was his association with the Massachusetts Audubon Society. At the Annual Meeting of that organization in January, 1951, he received an engrossed certificate for 52 years of service as a Member of the Board of Directors, and as Chairman of the Board for 30 years. He resigned as Chairman the following month but remained on the directorate until his death. For many years he contributed articles to the bulletin of that society, in recent years largely in the form of book reviews. His always friendly and definitely constructive criticism of bulletin material was a valued source of help to the editors of that publication. His interests focussed increasingly on this society during the last 15 years of his life. The association with an organization of popular rather than scientific nature may be due in part to his particular choice of friends, in part

to closely allied interests, such as the Massachusetts Conservation Council—it may in part be analogous to his ability to accept Thoreau's standard of ornithology.

Association with Ralph Hoffman, also a member of the Nuttall Ornithological Club at the time of Allen's election, developed his interest in protection, and he became much absorbed in this field, one so closely associated with Audubon work. He took an active part with Abbot H. Thayer in the controversy with Theodore Roosevelt on the question of color-patterns and their possible uses by birds and animals, display and concealment. Allen served as President of the Northeastern Bird Banding Association, 1926-1927, was a Fellow of the American Academy of Arts and Sciences, and a member of the National Audubon Society.

His published papers probably total well over 200, characteristically short, but showing breadth. They cover not only birds but muskrats, moles, woodchucks, and porcupines. At one extreme is a paper on the joys of sleeping outdoors, at the other one on the mathematical analysis of flight in cross-winds. While the quality of his papers runs high the papers themselves tend to be fragmentary and ephemeral. His greatest published contributions to ornithology are the so frequent notes on "Voice" and "Behavior" in Bent's *Life Histories*.

In the summer of 1953 Allen visited Cape Breton Island, Nova Scotia. Although he had for many years been careful not to over-exert himself with long walks over rough ground to avoid straining his heart, his enthusiasm in observing and making notes on the nesting of Wilson's Snipe, coupled with his advanced age, may well have led to the immediate and sudden recurrence of heart difficulties. His condition became rapidly and progressively worse. Hours, if not minutes, before he died he smiled gently at Laurence B. Fletcher's mention of recuperation in Fletcher's home in Cohasset and answered in a low, gentle voice, "In the sweet bye and bye."

3 Mercer Circle, Cambridge, Massachusetts, November 7, 1954.

VARIATION OF SHAPE IN THE EGGS OF THE  
COMMON TERN IN THE CLUTCH-SEQUENCE

BY MARY E. GEMPERLE AND F. W. PRESTON

A METHOD of describing with precision the shape of any egg was given previously by one of us (Preston, 1953). In an investigation of the eggs of the Laughing Gull (*Larus atricilla*), it was found (Preston and Preston, 1953) that there were three significant statistical differences between the first two eggs and the last egg of a clutch of three: (1) the last egg tended to be smaller in maximum diameter, (2) the radius of curvature of the big end tended to be less in the last egg, and (3) the parameter  $c_1$ , that measures the asymmetry of the egg, i.e., the extent to which the big end is bigger than the small end, is less in the third egg. No other parameter or measurement seemed to differ significantly with position in the clutch-sequence, nor was there any significant difference between the first and second egg in any of these particulars.

The question naturally arises whether the findings apply only to the Laughing Gull, or whether they are of much wider application. The present report concerns one additional species, the Common Tern (*Sterna hirundo*). We felt it desirable to sample a different genus in the same family (Laridae). The decision to work with this species was based on the same considerations as applied to the Laughing Gull, viz., the species breeds colonially, nests on the ground, normally lays three eggs and no more, and lays eggs of a convenient size.

The colony used was on an extensive sand and shell flat, just south of Stone Harbor, New Jersey, and the nests were the first of the season. (In the case of the Laughing Gull in 1952, the early nests were destroyed by high tides, and the clutches used probably represented re-nestings in all cases.) The field work was done in May of 1953 by Mr. and Mrs. F. W. Preston, with assistance from Mr. Herbert Mills of Bridgeton, New Jersey.

The method used was similar to that used with the Laughing Gull. Each morning, a visit was made to the sand-flat, where the birds were nesting in fair numbers in the little tussocks of grass. When a nest having only one egg was found, a cane was pushed into the sand nearby, and the date was written in pencil at two or three places on the egg. This was found just as satisfactory as using a colored crayon as was done with the Laughing Gull. The pencil marks did not rub or wash off, in spite of numerous torrential thunderstorms, especially if it was placed on the small end of the egg, which suffers

no attrition. The nests were revisited daily, and additional eggs were marked with the date on which they were first found. When three eggs were laid it was assumed the clutch was complete, and if all the eggs had been marked, the clutch was collected. The field work took about a week, May 18 to May 24. In the end we collected twenty-two clutches comprising sixty-six eggs, and this is the material reported on here.

Measurements of the eggs are by Preston, statistical work by Gemperle. Actual measurements were made only on length, maximum breadth, and curvature of the big end. All of these measurements were made on a special spherometer, described later in this paper, the spherometer becoming a simple "height" or "distance" gage when used with the circular plate described below. Length, when subjected to statistical analysis, was found to be without significance as in the case of Laughing Gull eggs. It was necessarily measured in the process of obtaining the "sink" which defines the curvature of the big end, and since it was measured it is here recorded. It may have some advantage as indicating the normality of this particular colony at this particular time, but plays no important part in this report. The breadth and the curvature of the blunt end were measured, because it was suspected, on the basis of the Laughing Gull work, that they might be "significant" variables.

The parameter  $c_1$  was not measured. Even in the field it was obvious that it was significant, for as a rule the last egg could be detected from a distance by its shape. Therefore, instead of contouring the egg, computing  $c_1$ , and obtaining quantitative data on it, a few qualitative experiments were made on the ability of observers to recognize the shape of the terminal egg. These experiments are described below.

*Field and Laboratory Data.*—Table 1 lists the sixty-six eggs by clutches (A, B, C, etc.) and by sequence in the clutch. It gives the date on which the egg was first observed in the nest. As a rule this was within twenty-four hours of its being laid, but those first seen on May 22 may have been laid somewhat longer, since no nests were visited on May 21. It gives also the length ( $l$  or  $2a$ ), maximum breadth ( $B$ ), and the "sink" ( $\delta_B$ ) for the large end when the three steel balls were a half-inch in diameter. The first two of these three quantities are the figures commonly listed in ornithological works as "length" and "breadth," and are all that are commonly listed in such works.

*Average Values of the Parameters.*—In table 2 are listed the average values of length, breadth, "sink," and radius of curvature of the big

TABLE 1  
MEASUREMENTS OF COMMON TERN EGGS BY CLUTCHES

Egg number	Date marked	<i>l</i> or <i>2a</i> Length (inches)	<i>B</i> Maximum breadth (inches)	$\delta_B$ "Sink"	<i>R<sub>B</sub></i> Radius of curvature
A1	May 18	1.5077	1.194	0.0525	0.5698
A2	19	1.6029	1.189	0.0565	0.5157
A3	20	1.6430	1.189	0.0625	0.4479
B1	19	1.7011	1.267	0.0506	0.5987
B2	20	1.7295	1.266	0.0504	0.6019
B3	22	1.7390	1.206	0.0631	0.4419
C1	19	1.5905	1.185	0.0520	0.5772
C2	20	1.6003	1.212	0.0583	0.4939
C3	22	1.6097	1.214	0.0536	0.5542
D1	19	1.6560	1.216	0.0597	0.4777
D2	20	1.6396	1.227	0.0548	0.5377
D3	22	1.7190	1.209	0.0570	0.5095
E1	19	1.6487	1.212	0.0535	0.5556
E2	20	1.5989	1.190	0.0574	0.5046
E3	22	1.6694	1.147	0.0632	0.4409
F1	19	1.5645	1.171	0.0484	0.6351
F2	20	1.5264	1.201	0.0526	0.5684
F3	22	1.5502	1.178	0.0551	0.5338
G1	19	1.7352	1.220	0.0623	0.4500
G2	20	1.7558	1.236	0.0563	0.5183
G3	22	1.7880	1.198	0.0611	0.4625
H1	19	1.6127	1.181	0.0585	0.4914
H2	20	1.6440	1.203	0.0525	0.5698
H3	22	1.6468	1.185	0.0588	0.4880
I1	18	1.6796	1.275	0.0454	0.6905
I2	20	1.6731	1.232	0.0593	0.4822
I3	22	1.7043	1.227	0.0662	0.4125
J1	20	1.6624	1.199	0.0556	0.5272
J2	22	1.5851	1.198	0.0565	0.5157
J3	23	1.6702	1.179	0.0601	0.4733
K1	20	1.7031	1.207	0.0582	0.4950
K2	22	1.6342	1.188	0.0585	0.4914
K3	23	1.6566	1.183	0.0637	0.4359
L1	20	1.7759	1.208	0.0583	0.4939
L2	22	1.7369	1.207	0.0558	0.5246
L3	23	1.7838	1.192	0.0613	0.4603
M1	20	1.6700	1.203	0.0530	0.5627
M2	22	1.6708	1.246	0.0544	0.5431
M3	23	1.6862	1.253	0.0577	0.5009
N1	18	1.6198	1.281	0.0519	0.5788
N2	20	1.6235	1.264	0.0505	0.6003
N3	23	1.6925	1.253	0.0579	0.4986
P1	20	1.5018	1.147	0.0549	0.5364
P2	22	1.5419	1.200	0.0539	0.5500
P3	23	1.5651	1.136	0.0611	0.4625
Q1	20	1.6548	1.201	0.0495	0.6166
Q2	22	1.7129	1.197	0.0573	0.5058
Q3	24	1.6629	1.139	0.0639	0.4341
R1	22	1.5745	1.222	0.0632	0.4409
R2	23	1.5924	1.214	0.0593	0.4822
R3	24	1.5686	1.178	0.0633	0.4398
S1	20	1.5916	1.189	0.0593	0.4822
S2	22	1.5808	1.198	0.0553	0.5311
S3	24	1.6000	1.212	0.0572	0.5070
T1	20	1.8146	1.223	0.0576	0.5022

TABLE 1 (Continued)

Egg number	Date marked	<i>l</i> or <i>2a</i> Length (inches)	<i>B</i> Maximum breadth (inches)	$\delta_B$ "Sink"	<i>R<sub>B</sub></i> Radius of curvature
T2	22	1.7037	1.206	0.0584	0.4927
T3	24	1.6978	1.194	0.0599	0.4756
U1	18	1.7485	1.216	0.0581	0.4962
U2	22	1.6766	1.199	0.0571	0.5083
U3	23*	1.6587	1.198	0.0567	0.5133
V1	20	1.7037	1.206	0.0538	0.5514
V2	22	1.5958	1.165	0.0582	0.4950
V3	24	1.6331	1.148	0.0664	0.4107
W1	20	1.6841	1.199	0.0553	0.5311
W2	22	1.6980	1.236	0.0563	0.5183
W3	24	1.7687	1.214	0.0628	0.4449

\* This may be an error: the correct date might be May 24.

Bent (1921: 240) says categorically of the Common Tern, "one egg is laid each day until the set is complete." We did not find this to be invariably the case, and therefore in this table we have included the dates of laying, or, more accurately, the dates when the eggs were first observed. As previously reported, all nests were examined every day except on May 21. It will be seen, for example, that birds Q, S, T, U, V, and W allowed four days to elapse between first and third eggs, not two days as indicated by Bent. Clutch N was even slower in reaching completion, requiring five days. The question naturally arises whether clutches that proceed slowly to completion show differences in egg-shape which do not parallel those in which completion is prompt. That question is not examined here, but the dates of laying are recorded in case other workers may some day find them useful.

Witherby *et al.* (1944: 32) says of the British colonies, "eggs sometimes laid on consecutive days, sometimes at intervals of at least two days." This agrees with the behavior of birds in our New Jersey colony.

end, together with their standard deviations computed on the assumption that the various parameters or variables have a Gaussian or normal distribution.

It will be obvious at once that, just as was the case with the Laughing Gull, there is no possibility of distinguishing between first and second eggs, but the third egg may be significantly different.

TABLE 2  
AVERAGE VALUES OF THE VARIOUS PARAMETERS AND THEIR STANDARD DEVIATIONS

	First egg	Second egg	Third egg	All eggs together
<i>l</i>	$1.6546 \pm 0.0802$	$1.6420 \pm 0.0627$	$1.6688 \pm 0.0669$	$1.6551 \pm 0.0703$
<i>B</i>	$1.210 \pm 0.0317$	$1.212 \pm 0.0254$	$1.192 \pm 0.0318$	$1.205 \pm 0.0307$
$\delta_B$	$0.0551 \pm 0.0045$	$0.0559 \pm 0.0026$	$0.0606 \pm 0.0035$	$0.0572 \pm 0.0043$
<i>R<sub>B</sub></i>	$0.5391 \pm 0.0621$	$0.5250 \pm 0.0349$	$0.4704 \pm 0.0386$	$0.5115 \pm 0.0549$

*Partition of Variance.*—We now proceed, as we did with the Laughing Gull, to assume that the egg may have measurements affected by three causes: (1) its parentage, i.e., it may vary according to the bird that laid it, (2) its sequence number, i.e., whether it is the first, second, or third egg of a clutch, and (3) all other causes combined, hereinafter called the "error." The methods of making the computations were described in the Laughing Gull paper and are standard

practice. Table 3 reports the results of the computations for the quantities  $l$ ,  $B$ ,  $\delta_B$ , and  $R_B$ .

This table shows that in the last three of these quantities there are significant differences correlated with the sequence in the clutch. It is obvious that the difference is between the last egg and the first, or between the last egg and the second, and not between the first and second eggs. These results all agree with what was found for the Laughing Gull.

TABLE 3  
COMMON TERN EGGS

	<i>l</i>	<i>B</i>	$\delta_B$	$R_B$
<i>No. clutches analyzed</i>	22	22	22	22
Computed variance ratio	Sequence: 3.18 Parentage: 10.10	7.57 5.60	16.25 1.25	14.45 1.26
F value for one per cent level	Sequence: 5.15 Parentage: 2.37	5.15 2.37	5.15 2.37	5.15 2.37
F value for five per cent level	Sequence: 3.22 Parentage: 1.81	3.22 1.81	3.22 1.81	3.22 1.81
Significance	Sequence: no Parentage: yes	yes	yes	yes
Variability	Sequence: 0.0009 Parentage: 0.0005 Error: 0.0013 Total: 0.0027	0.000766 0.000073 0.000350 0.001189	0.000061 — 0.000012 0.000073	0.00901 0.00002 0.00201 0.01104
Partition of variability (per cent)	Sequence: 33.3 Parentage: 18.5 Error: 48.1	64.4 6.1 29.4	83.6 — 16.4	81.6 0.2 18.2
Coefficient of variation (per cent)	Sequence: 1.8 Parentage: 1.4 Error: 2.2	2.3 0.7 1.6	13.7 0.6 6.1	18.6 1.0 8.7
Mean value of characteristic for	First egg: 1.6546 Second egg: 1.6420 Third egg: 1.6688 All eggs: 1.6551	1.210 1.212 1.192 1.205	0.0551 0.0559 0.0606 0.0572	0.5391 0.5250 0.4704 0.5115

*Sources of Error.*—In the field, the assumption was made that when a nest contained three eggs, the clutch was complete. Pough (1951: 286-287) states that three is a full clutch and seems not to give the bird any option of laying less or more, except possibly if it is immature. In conversation, however, he tells me that all he meant to imply was that three was the "normal" full clutch. Witherby *et al.* (1944: 32) report, "Eggs.—Generally 3, but often 2 and fairly frequently 4; higher numbers (5, 6, 9, 10 recorded) due to two or more females," while E. S. Thomas, in conversation, reports that he has frequently found two and four eggs in apparently authentic complete clutches on the shores of Lake Erie. Our assumption, therefore, that a clutch was complete when it contained three eggs, will presumably have a high probability

of being correct, but no absolute certainty. Out of our collection of twenty-two clutches, it is possible that one or more may have been incomplete. Some of the clutches that we marked (dated) never progressed beyond two eggs, but these we abandoned and did not collect. There was some predation, apparently by Herring Gulls, and eggs were sometimes removed from a nest and broken: such nests also we abandoned.

There is also the possibility that the birds parasitize each other, as Witherby above reports. Thus all eggs in one nest, even though three in number and laid at reasonably appropriate intervals, might not be laid by the same bird. There is a suspicion, on the basis of pigmentation, that this may have happened once, perhaps twice, in our collection of twenty-two clutches, and this suspicion is increased by the results of the tests described below.

It is our belief, none the less, that some ninety per cent of our clutches may safely be said to be both complete and unparasitized.

Before proceeding to the qualitative tests, it may be well to insert here a description of the spherometer. In a typical spherometer, a knife-edged ring sits on the spherical surface, and the height, to which a convex sphere projects above the plane of the ring, is measured. This height is known as the "sagitta." Sometimes, in fact often, the ring is reduced to a three-point contact on three needle-like "legs," or it may be reduced to two legs if the sphere is a very long-radius one and the operator can make a good guess at keeping the two legs in the diametral plane of the sphere.

We tried this arrangement, using the complete ring, but found that the eggs would not seat themselves firmly in it. The sharp edge "bit" into the egg shell and prevented it from moving smoothly and accurately into true position. We found it necessary to modify the seat, and this we did by substituting three hard steel "bicycle" balls for the ring. The three balls were of equal size, each touching the other two, and hence arranged, in plan view, in an equilateral triangle. They were held tightly together by being pressed gently into a recess that just accommodated them, as shown in figure 1. The balls were not free to rotate; they merely provided very smooth, highly polished, and very hard surfaces on which the egg shell slipped very easily. The points of contact, three of them—one for each ball, between ball and egg—depend on the curvature of the egg. It is not at the top surface of the balls, nor at the mid-plane thereof, and it varies when the size of the egg varies.

The reference plane of the apparatus, however, is taken as the top surface of the three balls. Let us now conduct an imaginary experi-

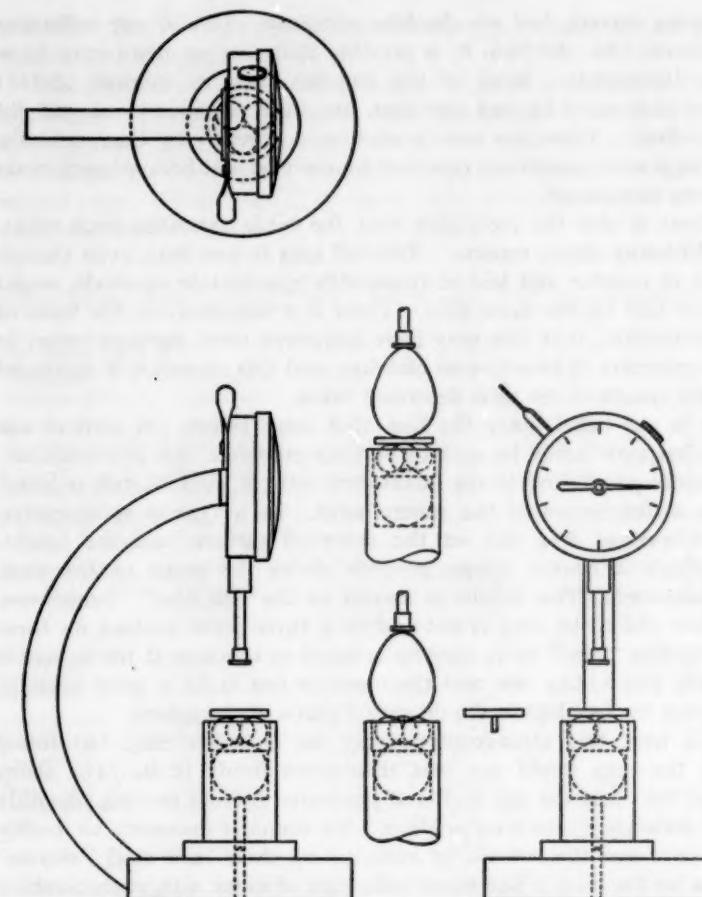


FIGURE 1. Special Spherometer. *Left*, side elevation; *right*, front elevation; *above*, plan view; *left center*, egg in the two positions for measuring curvature of big end; *right center*, one-tenth inch supporting disc.

ment. Set the egg on the imaginary reference plane, and measure its length. Then permit the egg to "sink" through the plane until it comes to rest on the actual steel balls. Take the reading of the dial gage again, and the difference of the two measurements is equal to the "sink" or "sinking-in," a quantity that replaces the "sagitta" of ordinary spherometer measurements.

Let the "sink" be  $\delta$ , and let the radius (semi-diameter) of each steel ball be  $r$ : then the radius of curvature ( $R$ ) of the end of the egg,

assuming that the part we measure is nearly enough a true spherical surface, is given by the formula:

$$R = \frac{2}{3} \cdot \frac{r^2}{\delta} + \frac{\delta}{2} - r \quad (1)$$

Since in practice the egg cannot be set for its first measurement upon an imaginary plane, it is actually set upon a little circular flat plate of thickness 0.1000". This plate has a little pin projecting from its lower side, of such a diameter that it can pass through the small triangular space left between the three balls. It is a loose fit in this space, with a very small amount of "play," but positions the circular plate with adequate accuracy and prevents it from sliding bodily away. The plate is removed for the second measurement, and the "sink" is then one-tenth of an inch less than the difference of the two dial-gage measurements.

To measure eggs of different sizes, it is convenient to have several different pedestals and balls of different sizes. The typical machinists' dial-gage reads only over a range of one inch. We have found it convenient to have pedestals increasing in height by half-inch intervals, and to provide, for each size of bicycle ball, two pedestals differing in height by half an inch. The tallest pedestals hold the smallest balls, of course, since they are used for measuring the smallest eggs. It is convenient to have a different circular plate for each size of ball, since the pin should "fit," although only loosely, between the balls.

A typical gage "reads" to one-thousandth of an inch, and can be "estimated" to a ten-thousandth. With eggs, we find we can estimate somewhat more closely than the thousandth, but not to the ten-thousandth.

Since there is a simple one-to-one relationship between the radius of curvature and the "sink," the statistical work can be done just as well on the sink as on the radius.

For purposes of comparison, it may be noted that the formula for the ordinary, unsatisfactory, spherometer is

$$R = \frac{D^2}{8\delta} + \frac{\delta}{2}$$

where  $\delta$  is the sagitta and  $D$  is the diameter of the knife-edged ring or the "pitch-circle" of the three legs. In many spherometer measurements, it is close enough to write  $R = D^2/8$ .

*Experiments on Picking out the Terminal Egg on Sight.*—These tests involve no measurement; a person is merely asked to judge by in-

spection. Two kinds of tests were made: the first, and by far the more difficult, denied the experimenter access to any material for comparison; the second let him compare the three eggs of a clutch.

(a) *Attempt to guess terminal eggs when seen separately.*—A random sequence of Common Tern eggs was prepared with the aid of a table of random numbers, and the eggs were given to one of us (F.W.P.) one at a time. The observer was to say "yes," if he thought an egg to be terminal, or "no," if he thought it was either first or second egg of a clutch. He did not know how many tests were in the sequence, nor the exact proportion of terminal eggs. He did know that it ought to be roughly one-third, but made no conscious use of the fact. On this basis, when in doubt he ought to have said "no," but did not do so, trying each time to make an honest estimate. He could not, however, divest himself of the knowledge that terminal eggs sometimes had characteristic arrangements of pigmentation, so that this additional source of knowledge must be assumed to have been present in his estimates. On the other hand, when eggs are seen separately, one at a time, there is no knowledge available from maximum width. It is known that in a clutch of three eggs, that egg which has the least maximum diameter is likely to be the terminal egg, but no use can be made of this knowledge in the present test. Hence, he must be assumed to have operated consciously only on the *shape of the blunt end of the egg* and subconsciously on the distribution of pigment.

It can be shown that if an experimenter is presented with  $(a + b)$  opportunities to guess,  $a$  being the number of normal eggs presented and  $b$  the number of terminal eggs, and if the experimenter says "yes"  $m$  times and "no"  $n$  times, then his expectation of success is

$$(an + bm) / (a + b)^2. \quad (2)$$

In the present test  $(a + b)$  was 31:  $a$  was 19,  $b$  was 12:  $m$  was 15,  $n$  was 16: hence the expectation of success, if the guesses had been absolute guesses, was

$$(19 \times 16 + 12 \times 15) / (31)^2 = 484 / 961 = 0.503, \quad (3)$$

or in other words, mere random guessing should have produced 50.3 per cent success.

Actually he "guessed" correctly on 19 eggs out of the 31, or 61.3 per cent.

He guessed correctly 7 out of 12 terminals, and 12 out of 19 non-terminals.

We are not quite sure how to calculate the likelihood of a 61.3 per cent success, on a 50.3 per cent probable success basis, in the

present instance. Nor are we sure that it is worth doing. The next experiment to be described is more revealing.

It should be added, however, that at the time of the test, the observer had not seen any of the eggs for several weeks, and it is unlikely that he remembered any of the eggs individually. They were presented to him in such a way that he could not see the pencil identifications on the back, near the blow-hole.

It seems likely that if he could not do better than 61.3 per cent, others who know less of the subject would not be strikingly successful at identifying an egg as terminal or non-terminal in the absence of companion eggs from the same clutch. See, however, below, under the heading "Reconsideration."

(b) *Picking out the terminal egg of a clutch by its shape.*—Operating again with the twenty-two clutches of the Common Tern, marked Clutch A, Clutch B, . . . Clutch W (but Clutch O being non-existent, no clutch was so marked), the experimenter was required to pick out the last egg of each clutch. His success or failure was unknown to him till all clutches had been reported. In each clutch there are three eggs, and random guessing will produce success 33-1/3 per cent of the time.

The first experimentalist was F. W. P., and the eggs were examined and success recorded by Mrs. Preston. The important difference now is that the experimenter can compare all eggs of a clutch and see the difference in shape, which is impossible when one egg at a time is examined.

All twenty-two clutches were examined and only a few seconds were allowed per clutch. Nineteen came out correctly, the exceptions being D, R, and U. The criterion was the shape of the blunt end, undoubtedly, however, taking subconscious note of pigmentation-arrangement.

To get over this last difficulty, we now tested Mrs. Preston. She had not seen the eggs for more than three months, and then only in the field. She did not know about the pigmentation. We explained that the third egg was the least blunt at the blunt end, and this had the effect of putting the "equator" further "south." She said she preferred to use this latter criterion, and immediately diagnosed correctly eighteen clutches out of twenty-two, being in error on D, K, T, and U. Note that D and U are clutches on which the previous observer was mistaken.

We therefore tested her again on these four clutches. She remained wrong on D, T, and U, but this time was correct on K.

The previous observer was now tested on D, R, and U. He remained wrong on D and U, but corrected R.

It is thus clear that D and U are abnormal, both observers being persistently wrong on these clutches. The probable reasons are discussed later, following table 4.

If, then, we omit Clutches D and U as being possibly abnormal on other evidence, we have almost 100 per cent success in picking out the terminal egg; and this is true whether done by an experimenter with some considerable background of observing these points, or by one with no background at all. Seeing that "chance" methods of picking out the third egg give only a 33 per cent success, while our success ran between 82 per cent and 100 per cent (the latter only if D and U are omitted as abnormal and suspect), it is clear that *without measurement*, but with the other eggs of the clutch available for *comparison*, the last egg is visually different.

(c) *Reconsideration of the previous experiment.*—It so happens that in the previous experiment, where, out of sixty-six eggs available, only thirty-one came up in the random series,  $U_3$  came up for diagnosis once, and  $D_3$  came up twice, and each time the experimenter (F. W. P.) gave a wrong answer. ( $U_1$ ,  $U_2$ ,  $D_1$ , and  $D_2$  did not come up at all.) It is obvious, therefore, that the random series was loaded with an abnormal number of dubious choices.

If we reject tests of  $D_3$  and  $U_3$ , the total number of tests was  $(a + b) = 28$ ;  $a = 19$ ,  $b = 9$ ;  $m = 15$ ,  $n = 13$ ; so the expected success was  $(19 \times 13 + 9 \times 15) / (28)^2 = 382 / 784 = 0.487$  or 48.7 per cent. Actually we had correct answers in nineteen cases out of twenty-eight, or 68 per cent.

This is sufficiently above the normal, "chance," expectation, that it means that terminal eggs can often be identified in the absence of companion specimens. However, the two experiments together show the great advantage of having the comparison eggs from the same clutch.

Table 4 shows the clutches in which the terminal egg would be correctly identified if the criterion were (a) that it has the least maximum-breadth in its clutch, (b) that it has the least radius of curvature, or maximum "sink," at the big end, (c) that it appears to Mrs. Preston to have its bulge most nearly at the mid-point or equator, and (d) that it appears to one of us (F.W.P.) to be the terminal egg by reason of a low value of  $R_B$  or of having "terminal pigmentation." We include also the possibility of identifying it as being the egg of greatest length.

The anomalous position of Clutch U is clear from the table. The egg that was presumed terminal does not appear to be so. Judging by the pigmentation the egg is *not* spurious (parasitic), and the most

likely interpretation is that this bird was prepared to lay a fourth egg, which would have been the genuine terminal egg and would have had the properties of a terminal egg.

In the case of Clutch D, there seems a likelihood that the egg marked D<sub>3</sub> may not have been laid by the same bird which laid D<sub>1</sub> and D<sub>2</sub>. Eggs D<sub>1</sub> and D<sub>2</sub> agree closely in background color and in pigmentation generally. Egg D<sub>3</sub>, on the other hand, has a darker background

TABLE 4  
COMPARISON OF VARIOUS METHODS OF DETERMINING TERMINAL EGG OF A CLUTCH

Clutch	Maximum length	Minimum breadth	Least value of $R_B$	Visual estimates F. W. P.	Visual estimates J. E. P.
A	x	x	x	x	x
B	x	x	x	x	x
C	x			x	x
D	x	x			
E	x	x	x	x	x
F			x	x	x
G	x	x		x	x
H	x		x	x	x
I	x	x	x	x	x
J	x	x	x	x	x
K		x	x	x	$\frac{1}{2}$
L	x	x	x	x	x
M	x		x	x	x
N	x	x	x	x	x
P	x	x	x	x	x
Q		x	x	x	x
R		x	x	$\frac{1}{2}$	x
S	x		x	x	x
T		x	x	x	
U		x			
V		x	x	x	x
W	x		x	x	x

altogether, and its spotting is also different. The shape of the egg is very definitely not what we expect in a terminal egg, and the fact that two of the measurements endorse it as terminal is perhaps merely coincidental.

If we assume that Clutch U is incomplete and that Clutch D contains a spurious terminal member, we reach very nearly 100 per cent success in identifying terminal eggs by inspection, and about 90 per cent by any one of several criteria.

*Comparison of British and American Common Tern Eggs.*—Witherby *et al.* (1944: 32) give the average dimensions of one hundred British Common Tern eggs as 40.99 mm.  $\times$  30.31 mm. These figures are substantially below the average of the present collection of sixty-six American Common Tern eggs. Table 5 records the comparison.

It is not certain that any of these collections is typical of Britain as a whole or of North America or even New Jersey as a whole. It does appear, however, that there is a possibility that the New World birds are slightly larger and more robust than the Old World birds. Both groups are assigned to the same subspecies (*Sterna hirundo hirundo*). The New Jersey birds are breeding in a distinctly more

TABLE 5  
COMPARISON OF AMERICAN AND BRITISH EGGS OF THE COMMON TERN

Source	Place in clutch	Number	Average length	Average maximum diameter	Reference
American (New Jersey)	First egg	22	1.6546" = 42.0 mm.	1.210" = 30.8 mm.	This report
	Second egg	22	1.6420" = 41.7 mm.	1.212" = 30.8 mm.	
	Third egg	22	1.6688" = 42.3 mm.	1.192" = 30.3 mm.	
	Overall average	66	42.0 mm.	30.63 mm.	
American	—	82	41.5 mm. (rounded off to nearest $\frac{1}{4}$ mm.)	30.0 mm.	Bent (1921:241)
British	—	100	40.99 mm.	30.31 mm.	Witherby <i>et al.</i> (1944:32)

Since the average size of the British eggs reported on by Witherby *et al.* is so much less than that of our New Jersey specimens, it seemed imperative to make at least an attempt to see if the difference is significant. In the case of the American eggs, we have not only the average length and average width, but also the standard deviations. In the case of the British ones, we have only the averages. In order to make a test of significance, we made the assumption that the standard deviation of the British eggs might very well be close to that found in the American ones. This may not be a very safe assumption, but it seems the only thing to do in the circumstances. Making this assumption, we find that there is a significant difference between the New Jersey eggs and the British ones: the difference is significant, by "Student's" *t*-test, at the 95 per cent level for width and at the 99 per cent level for length.

The explanation of this difference is not clear. It may be that our own specimens were taken from the birds that bred early and thus were the older birds or the more vigorous ones; and if we had sampled the colony at intervals throughout the breeding season, we might have found a change in average size. The British eggs may quite likely not all have been the earliest of the season. Since Bent's values, though "rounded-off," are slightly smaller than ours, though larger than those of Witherby *et al.*, this explanation may be the correct one. On the other hand, since his averages are definitely larger than the British ones, it may indicate that there is some real difference in size or vigor between the American and the British terns.

southern latitude than the British ones and therefore might be expected to be slightly smaller.

The point may be worth making that in all probability eggs can be measured with far greater precision than most parts of a bird's anatomy, and that subspecies might be detected earlier in the eggs than in the birds.

This paper is restricted to questions of shape. It was noted in the work on the Laughing Gull, and confirmed for the present species, that the terminal egg commonly has a different and characteristic arrangement of the pigmentation. On this we may report later.

While the Common Tern eggs were being marked and collected, nests

of the Least Tern also were encountered, marked, and in some cases collected. This species seems to lay two eggs as often as three, and an effort was being made to collect only three-egg clutches. Partly on account of this restriction, but more on account of the nightly thunderstorms that flooded the flats and destroyed the nests, an insufficient number of clutches was obtained for quantitative work; but on a qualitative basis it seems very likely indeed that what has been found true for the Laughing Gull and the Common Tern applies also to the Least Tern.

*Other Differences between Terminal and Earlier Eggs.*—We have now established that, in the Laughing Gull and the Common Tern at least, the last egg of a clutch differs from the other eggs in two particulars, size and shape ( $B$  and  $R_B$ ). It is, therefore, likely that it differs in other particulars of a less obvious nature. We know that it differs in character of pigmentation (vermiform spots, and concentration of spots in a ring). We know also that it is frequently different in background color, which may be either lighter or darker; but sometimes the *first* egg is the odd one in this respect. There may be more subtle distinctions, such as texture of the shell, its porosity, and its surface gloss.

It appears to us that, judging from the ease of removing pencil marks from the shell, the big end is more porous or less glossy than the small end of an egg, and the last egg of a clutch is often less glazed than the others. This would agree with what we suspect about the Brazilian Seriema (*Cariama cristata*), a distant relative of the cranes that lays two eggs (like the cranes), but one egg is very glossy and the other very mat.

*Conclusion.*—There is a significant difference between the shape of the third (last) egg of the clutch of the Common Tern and the shape of the first two eggs. These differences are similar to those previously found in the eggs of the Laughing Gull.

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*Preston Laboratories, Box 149, Butler, Pennsylvania, November 25, 1953.*

*Erratum.* In the previous paper (Preston, 1953: 179), the length of the Lapwing's egg was given as 40.7 mm. This should read 49.7 mm. This slip does not affect any calculation or any other statement in that paper.

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#### INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

Notice is hereby given that the possible use by the International Commission on Zoological Nomenclature of its Plenary Powers is involved in applications relating to the under-mentioned names included in part 3 of Volume 11 of the *Bulletin of Zoological Nomenclature*, published on 28 February 1955:

*obscura* Berezowsky and Bianchi, 1891, as published in the combination *Larvivora obscura*, validation of (pp. 93-94). Z.N. (S.) 876.

*bei* Ridgway, 1874, as published in the combination *Eremophila alpestris* var. *bei*, suppression of (pp. 103-104). Z.N. (S.) 817.

Any specialist who desires to comment on either of the foregoing applications is invited to do so in writing to the Secretary to the International Commission (Address: 28 Park Village East, Regent's Park, London, N.W. 1, England). Comments should be marked with the Commission's File Number as given in the present notice and should reach the Secretariat by 28 August 1955.

Francis Hemming  
Secretary

REMARKS ON THE PIGEON, *OTIDIPHAPS NOBILIS* GOULD

BY FRED H. GLENNY AND DEAN AMADON

THE members of the family Columbidae have, in general, a normal, U-shaped furcula. Years ago Milne-Edwards (1869-1871) noticed a partial reduction of the clavicles in certain fruit pigeons and wrote "quelque fois même ses deux branches [of the furcula of pigeons] ne se soudent pas ensemble, et sont trop courtes pour se recontrer sur la ligne médiane, de façon qu'elles sont réduites à l'état de stylets. Cette anomalie existe chez les Trérons, les Carpophages, les Phaenorhines, et les Serrésies." In the accompanying Atlas he figured this condition in *Ducula (Phaenorhina) goliath* from New Caledonia. This drawing was reproduced in Stresemann (1927-1934).

This modification of the clavicles does not seem so widespread as Milne-Edwards implied in the sentence quoted. We found a normal furcula in the following species: *Ducula luctuosa*, *D. bicolor*, *D. aenea*, *D. pacifica*, *D. concinna*, *Sphenurus sphenurus*, *Treron pompadoura*, *T. bicincta*, *T. calva*, *T. olax*, and in two or three species of *Leucoteron* but were unable to examine a specimen of *Ducula (Serrisius) galeata* of Nukuhiva Island in the Marquesas. Like *Ducula goliath*, it is a large, insular species possibly of somewhat weaker flight than the majority of the members of the genus and so may very well, as Milne-Edwards stated, have reduced clavicles.

A much greater reduction of the furcula than in *Ducula goliath* was discovered by the senior author while dissecting two specimens of the remarkable New Guinea pigeon *Otidiphaps nobilis* in the collection of the American Museum of Natural History. Dissection of the shoulder joint revealed the presence of a small bone (epicleidium) in close articulation with the medial face (clavicular process) of the head of the coracoid. The epicleidium is reduced and the corpus claviculi, which extends ventrally from the epicleidium for a short distance (2 mm.) is almost entirely lacking. There appears to be no true interclavicular vestige or pons claviculi remaining in the adult bird. What appears to be a minor reduction in the lateral process of the foot of the coracoid produces a less acute angle of the lateral process than is found in most pigeons. Total length of the vestigial clavicle is approximately 4 mm.

The sternum is elongate and somewhat narrower than in most other members of the family. The external-lateral xiphoid processes are long and gently curved (not abruptly angular), and the internal-lateral xiphoid processes are fused with the median xiphoid process

as in other species of the Columbidae. The fenestrae sterni are divided—the posterior fenestrae are small and nearly obliterated. The rostrum sterni is broad, not typically "forked" as in other species of the Columbidae.

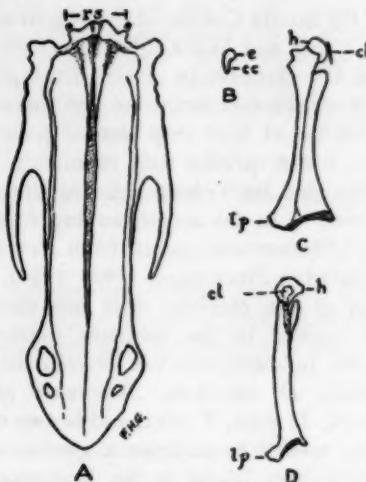


FIGURE 1. Pectoral girdle of *Otidiphaps nobilis*. Approximately three-fourths natural size. A, ventral view of the sternum; B, medial view of the vestigial clavicle; C, ventral view of the coracoid; D, medial view of the coracoid: cc, corpus clavicularis; cl, location of vestigial clavicle with respect to the head of the coracoid; e, epicleidium of clavicle; h, head of coracoid; lp, lateral process of foot of coracoid; rs, rostrum sterni.

Unlike other members of the Columbidae thus far studied, specimens of *Otidiphaps nobilis* have a coracoid major and two coracoid minor (sterno-clavicular) arteries. This condition is in contrast with the normal one or two pairs of coracoid arteries present in other species. Furthermore, the origin of the axillary artery from the subclavian artery is such that the coracoid major artery appears to arise almost entirely from the pectoral stem or nearly opposite the site of the axillary artery. This vessel is usually found to arise from the subclavian at a point between the common carotid and the axillary arteries. While a ligamentum aortae is present, no vestige of the ligamentum botalli could be observed.

*Otidiphaps nobilis* has always been regarded as one of the more aberrant members of the family Columbidae. Heavy bodied, with long, strong legs and feet, a captive specimen observed by Dr. J. P. Chapin walked about, he tells us, more like a partridge than a typical

pigeon. The generic name *Otidiphaps*, bestowed by Gould, meaning "bustard-pigeon" refers to the strong legs and heavy body of this bird. In keeping with its terrestrial way of life, the wings of *Otidiphaps* are somewhat reduced as compared with its bulk as shown by the accompanying table, based chiefly on data from Mayr (1931). In this connection, the area of the wing would be more significant than its length, but we may state from direct examination that the wings of *Otidiphaps* are relatively small as well as short. *Otidiphaps* is not flightless. Rand (in Mayr and Rand, 1937, p. 431) observed: "this is a bird of the forest floor where it apparently feeds. . . . It was rather wary . . . flushing with a loud clatter of wings and flying out of sight in the forest."

TABLE I  
BODY WEIGHTS AND WING LENGTHS FOR INDIVIDUAL SPECIMENS  
OF CERTAIN NEW GUINEA PIGEONS

Species	Weight	Wing Length
<i>Otidiphaps nobilis cervicalis</i> (♂).....	525 gm.	198 mm.
<i>Otidiphaps nobilis cervicalis</i> (♂).....	475 gm.	187 mm.
<i>Columba vitiensis halmahera</i> (♀).....	450 gm.	230 mm.
<i>Reinwardtoena reinwardtii griseotincta</i> (♂).....	325 gm.	248 mm.
<i>Columba albertisi albertisi</i> (♂).....	300 gm.	206 mm.
<i>Macropygia amboinensis kerstingi</i> (♂).....	150 gm.	168 mm.
<i>Gallicolumba beccarii beccarii</i> (♂).....	70 gm.	109 mm.
<i>Henicophaps albifrons</i> (♂).....	300 gm.	203 mm.
<i>Henicophaps albifrons</i> (♂).....	344 gm.	194 mm.

The above remarks imply that the loss of the furcula in *Otidiphaps* may be correlated with a weakness in flight. In birds, the principal thoracic support is, of course, supplied by the coracoids, not the clavicles. In some Australian parrots (*Platycercus* and related genera) and in a few barbets, the clavicles are vestigial but flight is, so far as known, normal for the group. On the other hand, loss or reduction of the clavicles often is found in birds that cannot fly, or fly but weakly. Examples are the ratites, the New Zealand Owl Parrot (*Strigops*), the nearly flightless gruiform birds of the family *Mesoenatidae* of Madagascar, and the dodo (*Raphus*). There is not much doubt, therefore, that a decrease in the size of the clavicles is sometimes one of the eventual anatomical results of a decreased use of the wings. This may well be the explanation in *Otidiphaps*. For a further discussion of this question see Glenny and Friedmann (1953).

The modifications of the clavicles and arteries are not the only distinctive features of *Otidiphaps*. The number of tail feathers,

twenty to twenty-two, exceeds that of any other columbid. The usual number in the family is twelve, or in some species fourteen, while in the Crowned Pigeon (*Goüra*), it reaches sixteen. Also unique is the presence of a row of well defined rectangular scutes down each side of the posterior half of the strong tarsi. Even *Goüra*, with its long heavy tarsi, shows no tendency towards the development of such scutes.

All in all, *Otidiphaps* seems to deserve subfamily rank as much or more than do two genera to which Peters (1937) has individually given this rank. They are *Goüra*, already mentioned, and the Tooth-billed Pigeon (*Didunculus*) of Samoa. The latter is perhaps not as aberrant as once supposed. As for *Goüra*, the wisdom of separating it from the smaller *Microgoura* of the Solomon Islands is dubious.

*Otidiphaps* has some slight resemblance in color and in the texture of the feathers to *Goüra*. The latter, while equally strong-legged, spends much time in the trees. It has a normal furcula. Whether these genera are related is difficult to say. They are both Papuan and may be allied, though not closely, to each other and possibly to some of the less specialized terrestrial forms found in the same region. We suggest that the unusual characteristics of *Otidiphaps* be evaluated not as a basis for setting it up in a subfamily but rather as an indication of variability in the Columbidae of a degree to justify suppressing the *Goürinae* and the *Didunculinae* of Peters' Check-list. This leaves two large subfamilies, the fruit pigeons (*Treroninae*) and the "typical" doves and pigeons (*Columbinae*), but as Stresemann (*op. cit.*) has emphasized, the former group (and probably the latter) seems to be polyphyletic. It may be advisable to recognize no subfamilies at all in the Columbidae until the group has been thoroughly studied.

One of the two specimens of *Otidiphaps* was collected by Mr. E. Thomas Gilliard, to whom we are also indebted for the weights and measurements of *Henicophaps albifrons* given in the table. Mr. Gilliard also helped with the manuscript, as did Dr. Ernst Mayr.

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*Youngstown College, Youngstown 2, Ohio, and American Museum of Natural History, New York City, December 16, 1952.*

#### NOTES AND NEWS

Through the generosity of Mrs. Tucker, the funds available for the Marcia B. Tucker Award in Ornithology have been increased this year. These funds are used to assist promising young ornithologists in attending the annual meeting of the American Ornithologists' Union. With the increase in funds, the award this year will be extended to two or more people. The amount in each instance will depend upon the distance to be traveled.

Any member may nominate people for this award. Nominees need not be members, but it is hoped that they may intend to present papers at the meeting. Information should include the following items:

1. Name, age, and address of nominee.
2. Education and experience of nominee.
3. Statement by the sponsor about the capabilities, special interests, and financial need of the nominee.

This information should be sent to the Secretary (Harold Mayfield, 2557 Portsmouth Ave., Toledo 13, Ohio) not later than August 1, 1955. The officers of the A.O.U. will serve as a committee to name the awardees.

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#### ARTHUR CLEVELAND BENT'S LIFE HISTORIES OF NORTH AMERICAN BIRDS

Some years ago Mr. Bent, who died on December 30, 1954, arranged with James Lee Peters, at that time President of the Nuttall Ornithological Club, to have that organization agree to sponsor preparation of the remaining Life Histories should such action prove necessary. More recently, Mr. Bent had the Club appoint me Chairman with free hand to choose my own Committee, and in May, 1954, he turned his work over to the Committee. Members are: Mrs. A. C. Bent, Dr. Alfred O. Gross, William G. F. Harris, Dr. Frederick C. Lincoln, Dr. Robert A. Norris, Christopher M. Packard, Dr. Lawrence H. Walkinshaw, and myself. Contributions of material and photographs will be welcome as before and may be sent to the most convenient member of the Committee.

It is hoped the volume on the Icteridae will go to the printer in the spring of 1955. No change in format is planned.

Wendell Taber, Chairman,  
Bent Life History Committee,  
Nuttall Ornithological Club

## GENERAL NOTES

**Feeding Habits of the Everglade Kite (*Rostrhamus sociabilis*).**—Thirty years ago, Herbert Lang (Nautilus, 1924, 37: 73-77) gave the first description of the manner in which the Everglade Kite extracts the gastropod *Ampullaria* from its shell. The title of Lang's article has found its way into ornithological citations, as in Bent (Bull. U. S. Natl. Mus., 167, 1937) and Strong (Bibliography of Birds, 1939), but, very curiously, the content of his paper has apparently been ignored by ornithological writers. I have watched in vain for the truth as text after text discussing the Everglade Kite has been published. The matter has just been brought again to my attention by the appearance of Sprunt's Florida Bird Life (1954), which merely quotes the largely incorrect account from Howell's book of the same title (1932). This is:

"Upon seizing a snail in its sharp talons, it carries it to a bush or a little mound, where the mollusk is extracted from its shell with the sharp, hooked bill of the bird and swallowed in pieces about a half or three-quarters of an inch in length. The snails are sometimes shifted from the foot to the bill and occasionally are eaten by the kite while flying. The shells are unbroken, as a rule, although occasionally one is seen with a puncture in the side."

It is evident that the facts should no longer be left concealed in a conchological journal that ornithologists fail to open. I have had the opportunity to confirm Lang's observations, made in British Guiana, during field work in the vicinity of Estancia La Segunda, Chascomús, Argentina.

The Everglade Kite does not pull or tear *Ampullaria* out of its shell. The kite's bill is not only extremely slender terminally but is also delicate and relatively flexible. The ring muscles of the snail, on the other hand, are extraordinarily tough. It would require much more horse-power than the bird possesses to obtain its prey by main force, and subsequently to rend it into small pieces.

On the pampas in the Province of Buenos Aires, January 28, 1954, the astonishing numbers of *caracoleros* or snail hawks were amazing to one who had known only the pitiful remnant of the species in Florida. While slithering in a motor car along extremely muddy roads, we passed hundreds of the birds, many sitting calmly on roadside fence posts as we passed. I stopped to pick up several clean and perfect *Ampullaria* shells that the kites had dropped, one of which hit the ground just before I obtained it. The feeding technique, the discovery of which should be credited to Herbert Lang and which is here recorded partly in his own words, is as follows:

The kite darts and skims about over the pools and their shores, and, after spying a snail, it grasps it in one foot and at once flies to a perch. The period of hunting is usually late afternoon or at some other hour when the sun glare is reduced. It is then that the snails move about most, and crawl from the water onto the stems of the low vegetation.

The kite must have a perch to enjoy the fruits of its search. It sits on one foot and holds the snail gently in the other, doing nothing that would inhibit the mollusk from emerging from the whorl of the shell. The bird makes no effort to obtain its food by force; it waits for the voluntary extension of the animal beyond the aperture. When that happens, the bird quickly pierces the snail behind the operculum, always in the same place which is evidently a nerve plexus.

The kite then sits and waits again, with the snail spiked on its maxilla, from which it stands out like a bump as large as the bird's head. Gradually the muscles of the numbed snail relax. After two minutes, more or less, the kite vigorously shakes its head and swallows the mollusk whole, operculum and all, before the empty shell has reached the ground.

The fragile shell is never broken or abraded by the captor. The long, slender bill is used not as a hook but as a lancet or poniard. It is a feat of instinctive correlation as exact as that of the spider-paralyzing wasps.—ROBERT CUSHMAN MURPHY, *American Museum of Natural History, New York.*

**Possible Function of the Flicker's Black Breast Crescent.**—For periods of 75 and 20 minutes, on July 15, 1954, I watched a male Flicker (*Colaptes auratus*) work over the lawn of a Baltimore park, accompanied by two juveniles. The latter were practically full-grown and on the verge of becoming independent; one, in particular, foraged much for itself, neither was ever fed without having solicited the feeding, and one or both were sometimes pecked at and driven away by the adult when they did solicit. The manner of their solicitation was, almost invariably, to nuzzle directly into the parent's breast, to run rapidly beneath his throat from one side to the other, or to stroke his breast with the bill. The performances suggested that the black crescent on the breast of this species functions as a directive marker, or "target," for such food solicitation; lying as it does over the lower part of the throat, pressure exerted on or near it in the ways observed might very well stimulate regurgitation, it seems—and, in fact, regurgitative feedings did sometimes follow immediately.

My notes on the food solicitation and feedings, made at the time, follow:

4:15 P.M. One of the juveniles nuzzles directly forward against the male's breast, and thereupon is fed briefly by regurgitation. Twice before, during the half-hour I have already watched, the juvenile that was closely accompanying the male had crawled rapidly across under his throat from one side to the other, but no feedings followed and I did not realize what now appears to be the case—that this was solicitation.

4:39. A juvenile rubs against the male's right side at the front of his body, then goes close directly in front of him and holds up its open bill, and is fed.

4:41. A juvenile goes in front of the male and, without touching him, holds its bill open and is fed.

4:48. A juvenile runs across, from right to left, directly or virtually under the male's black crescent; then, from the left, soon goes under the male and nibbles at his throat.

4:50. A juvenile again runs across under the male's throat, from his right to his left.

4:51. Both young repeatedly run under the male, simultaneously but in opposite directions, distinctly posterior to the crescent, and after some seconds the male feeds one.

4:53. A juvenile repeatedly nuzzles the male, first from his right, then from his left, then from directly in front with head low and finally motionless between the male's legs. All of this nuzzling was well posterior to the crescent (except that of course the juvenile's back must finally have been pressing against that) and all of it was vain; but may not the crescent still have been the "target"?

6:38 P.M. A juvenile goes up to the male and from directly in front rubs its bill up and down once or twice against his breast, crossing the crescent vertically. No feeding made.

6:49. The male passes in front of a juvenile, and as he does so it nibbles at his chin and breast. He does not feed it.—HERVEY BRACKBILL, 4608 Springdale Avenue, Baltimore 7, Maryland.

**Status of the Black-polled, Bay-breasted, and Connecticut Warblers in Middle America.**—In preparing a list of the birds known from Mexico to Panamá, certain published Middle American records were found to be erroneous, affecting to some degree the assumed status of these warblers.

The Black-polled Warbler (*Dendroica striata*), as is well known, reaches its wintering grounds in northern South America through the West Indies. The A.O.U. "Check-List of North American Birds": 291, 1931, states that it is "casual" in Mexico, without mention of any locality, and this was repeated by Hellmayr in his "Catalogue of Birds of the Americas" (Field Mus. Nat. Hist., Zool. Ser., 13, Pt. 8: 404, 1935). Dr. Frederick C. Lincoln informed me that, so far as he knew, the sole basis for the "Check-List" statement was one specimen taken by Sumichrast at Tehuantepec City, Oaxaca, Mexico, on October 19, 1869, which had been erroneously reported in the literature as a Bay-breasted Warbler, *D. castanea* (Lawrence, Bull. U. S. Natl. Mus., 4: 15, 1876), according to W. W. Cooke (U. S. Dept. Agr., Div. Biol. Surv. Bull. No. 18: 75, 1904). Curiously enough, despite Cooke's comment, this Tehuantepec specimen was cited by Hellmayr in 1935 as the only Mexican record for *D. castanea* (*op. cit.*: 403), and more recent writers have repeated the reference. Thus, unknowingly, ornithologists have used the same specimen as the basis for supposed Mexican records of two species. The error apparently has persisted because of reliance on the attribution of the Tehuantepec specimen to *D. castanea* in the body of Ridgway's "Birds of North and Middle America" (Bull. U. S. Natl. Mus., 50, Pt. 2: 594, 1902) and failure to note that at the back of the same volume, in the Addendum (*op. cit.*: 785), Ridgway made a correction, ultimately identifying the bird as *D. striata*. To remove doubt, I inquired of Dr. Herbert Friedmann at the U. S. National Museum, where the specimen still exists, and he confirms that it is definitely a Black-polled Warbler. This lone Mexican record appears also to be the only specimen from anywhere in Middle America, excluding the West Indies.

The Bay-breasted Warbler regularly winters in Panamá, Colombia, and Venezuela, as Bent points out ("Life Histories of North American Wood Warblers," Bull. U. S. Nat. Mus., 203: 380, 387, 1953), but it has been taken more frequently in Mexico and Central America than one would suppose from examining Bent, Hellmayr, and Ridgway, who give the impression that the bird is accidental in that area. Ridgway and Hellmayr mention only the erroneous Tehuantepec record and one collected by Skinner in Guatemala, reported without locality (Slater and Salvin, *Ibis*, 1859: 11). Actually the Bay-breasted Warbler must often occur on the Gulf coast of Mexico, if, as has been stated, it is regular on the adjacent coast of southern Texas (Williams, Auk, 62: 103, 1945). The American Museum has three examples taken at Brownsville, Texas, just across the Rio Grande, on May 4 and 7, 1909, and Sutton and Pettingill record taking one in Mexico at Gomez Farias, southern Tamaulipas, on April 2, 1941 (Auk, 59: 28, 1942). In Panamá this species is a regular and not uncommon winter resident at least from the Canal Zone eastward, and specimens have been taken during the migration period near the Costa Rican border at Cocoplum, Bocas del Toro. It seems wholly unlikely that these small birds should fly between the Gulf coast of the United States and Panamá—some 1,500 miles—without stopping, particularly as the course would carry them, at convenient intervals of about 500 miles, over the Yucatan Peninsula and the "hump" of Honduras-Nicaragua. In fact there is direct evidence that some, at least, do pause on the Yucatan Peninsula, for Paynter reports collecting three and seeing others on May 6 and 7, 1949, near Chetumal, Quintana Roo (Postilla, 2: 6, 1950). In addition to the Guatemalan record, Salvin and Godman record

in the tabular list of their introduction to "Biologia Centrali Americana, Aves": 1: xv, 1904 (which was published last) specimens from both British Honduras and Costa Rica, received after the main work had been finished. These records seem to have been overlooked by subsequent writers. Further, Salvin reported that this species was collected by Gaumer on Ruatan, one of the Bay Islands on the Caribbean coast of Honduras (*Ibis*, 1888: 249), and Rendahl lists two taken at San Juan del Norte, a Caribbean port in southern Nicaragua, on October 26 and 27, 1881, by Dr. C. Bovalius (*Arkiv för Zool.*, 12 (8): 35, 1919). There are two Costa Rican specimens in the University of Michigan Museum of Zoology, one taken October 28, 1950, at El Sauce, Cartago Province, and one April 20, 1952, at La Lola, Madre de Dios, Limón Province. As Bond reports *D. castanea* to be only a "rare transient in western Cuba" ("Check-List of Birds of the West Indies" third ed.: 143, 1950), it is unlikely that the West Indies is the major migration route for the Bay-breasted Warbler. The spottiness of the published reports from Central America and Mexico probably reflects the small amount of collecting done in the coastal Caribbean forests during the brief period when this species pauses in its migration through the area.

The Connecticut Warbler (*Oporornis agilis*) winters in Brazil, and perhaps also in Colombia and Venezuela, where it has been recorded on migration. Between the United States and South America the only published reports seem to be a few from the Bahamas and one supposedly from San José, Costa Rica (Bent, *op. cit.*: 523-524). Judging from the regular occurrence in Florida on migration, the natural assumption is that it uses the West Indies route, yet James Bond says he knows of only one specimen report from the Antilles. On checking the basis for the supposed San José, Costa Rica, record, Dr. Lincoln informed me that according to old files of the Biological Survey such a specimen taken October 6, 1890, was in the Thayer collection, at the Museum of Comparative Zoology. Ludlow Griscom, who courteously examined the specimen for me, reports that it is actually a Mourning Warbler (*O. philadelphica*)—a species well-known in Middle America. There thus seems to be no Middle American record of the Connecticut Warbler.

I am very grateful for the hearty cooperation given by Dr. Lincoln, Dr. Friedmann, and Mr. Griscom.—EUGENE EISENMANN, Linnaean Society of New York, 11 Broadway, New York 4, N. Y.

**The Type Locality of the Florida Sandhill Crane.**—Peters (Auk, 1925, 42: 121) separated the Florida subspecies of the Sandhill Crane as *Megalornis canadensis pratensis*, based on *Grus pratensis* F. A. A. Meyer (1794, *Zool. Annal.*, 1: 286, 296). Meyer had simply adopted the name *Grus pratensis* from Bartram's Travels and introduced it into binomial nomenclature in a review of that work. Bartram obtained (and ate) this crane on the eastern part of Alachua Savanna.

Peters erroneously believed that this locality lay within the boundaries of the present Clay County, Florida, and accordingly designated Clay County as the type locality. This designation has been followed in the A.O.U. Check-List (ed. 4) and in other standard works.

However, the locality called Alachua Savanna in Bartram's day lies entirely within the south-central portion of Alachua County, Florida. Its center is about six miles south of Gainesville. Today it is crossed by U. S. Highway 441 and is known by the name of Paynes Prairie. Sandhill Cranes are still resident on Paynes Prairie. Accordingly it is obvious that the proper type locality of *Grus pratensis* Meyer is Paynes Prairie (Alachua Savanna), Alachua County, Florida.—PENRICE BRODKORB, Department of Biology, University of Florida, Gainesville, Florida.

**A Gull New to North America.**—On November 26, 1954, my attention was attracted to a strange gull among a large group of Ring-billed Gulls (*Larus delawarensis*), California Gulls (*L. californicus*), and Western Gulls (*L. occidentalis*) at the U. S. Naval Training Center on San Diego Bay, San Diego, California. This bird appeared slightly larger than a California Gull, possessed a dark mantle similar to that of a Western, and had the bright yellow legs and pale yellow iris of a Ring-billed. The bill was yellow basally, was crossed by a complete black band, and was tipped with red. Most striking was the well-marked complete black band on the white tail.

I first thought that the bird was an escape from the San Diego Zoo, but a check with Kenton C. Lint, Curator of Birds at the zoo, indicated that no gull of this description had been in captivity there in more than ten years. The only gulls fitting this description were the Belcher's Gull (*L. belcheri*) of South America and the Japanese Gull (*L. crassirostris*). The San Diego Zoo had a few of the former over a decade ago. A further check indicated that no other zoo on the West Coast had ever had either species in captivity.

I collected the bird on November 28, in the same locality, and it proved to be an adult female in excellent condition and rather fat. It disgorged several small fish upon being collected.

The specimen has been deposited in the University of Michigan Museum of Zoology collection (catalogue No. 136,176) and was determined to be *Larus crassirostris* by Dr. Robert W. Storer. It marks the first occurrence of the Japanese Gull on the North American continent. *Lt.J.G. BURT L. MONROE, Jr., U. S. Naval Training Center, San Diego, California.*

**Eastern Willet in Ohio.**—On May 17, 1952, we collected a Willet at the State Fish Hatchery, Lake St. Marys, Ohio. In the field, the bird appeared very dark and small. Examination of this specimen in the hand convinced us that it belonged to the eastern race, *Caloptrophorus semipalmatus semipalmatus*. The specimen is a female in spring plumage, wing, 185 mm.; tail, 71 mm.; culmen, 51 mm.

The specimen was sent to Dr. Harry C. Oberholser, who informed us that this was the only substantiated inland occurrence of this race for the United States since Rinker's record from Hamilton, Kansas (Auk, 31: 105, 1914), which was the only one included in the Fourth Edition of the A.O.U. Check-List (1931). The present location of the Rinker specimen could not be ascertained by the writers. Although there have been many published reports of the occurrence of this race from various inland localities, all specimens examined have been referable to the western subspecies, *C. s. inornatus*.

The Ohio specimen is now in the collection of the University of Cincinnati.—  
**WORTH RANDLE and EMERSON KEMMIES, University of Cincinnati, Cincinnati, Ohio.**

**A new race of Least Bittern from Peru.**—The population of *Ixobrychus exilis* in western Peru evidently pertains to an undescribed race for which I propose the name

*Ixobrychus exilis peruvianus*, new subspecies.

**Type:** A.N.S.P. no. 115899, adult male, collected February 6, 1932, by M. A. Carriker, Jr., at "Végeta" (= Végueta), Department of Lima, Peru.

**Diagnosis.**—Readily distinguishable from the two other South American races, *I. e. erythromelas* (Vieillot) and *I. e. bogotensis* Chapman, by longer bill and much duller sides of head and neck and under parts. Most closely resembles *I. e. hesperis*

Dickey and van Rossem, of western North America, but sides of head and neck grayish brown, more or less tinged with buffy; under parts washed with buffy gray and ochraceous buff; center of abdomen buffy rather than white. The grayish hue of the under parts is quite striking in the three adult specimens examined.

*Measurements of type.*—Wing (pressed flat against ruler) 127, tail (from bases of middle rectrices) 44, bill (exposed culmen) 52.5, tarsus 44 mm.

A second adult male from Végueta has the following measurements: wing 126.5, tail 43, bill 52.5, tarsus 42.5 mm. A female in the British Museum from Trujillo has a wing of 122, bill 47.5 mm.

*Range.*—Coastal Peru, from the Department of Libertad (Trujillo, Pacasmayo) south to the Department of Lima ("Lima," Végueta).

*Specimens examined.*—*I. e. exilis*, long series from eastern North America; *I. e. hesperis*, 5 males and a female from Lower California; *I. e. bogotensis*, male (type) and female from Colombia; *I. e. erythromelas*, short series from the Guianas and Trinidad south to Bolivia; *I. e. peruvianus*, two adult males and a juvenile male from Végueta and a female from Trujillo.

*Remarks.*—The two adult males from Végueta were collected on February 2 and February 6, 1932; they had enlarged testes. The male in juvenal plumage, collected February 2, had evidently not been long out of the nest, for there is still a considerable amount of down adhering to the feathers, particularly on the pileum, scapulars, rump, upper tail coverts, and at the tips of the rectrices. Under these circumstances, I fail to understand why Mr. Carricker considered his specimens winter residents of *I. e. hesperis* of western North America (Auk, 1926, 53: 323). In addition to those collected, Carricker observed "several others, mostly immature birds," at Végueta, and the species has been recorded from Lima, October 10 and October 16, 1889 (Berlepsch and Stolzmann, Proc. Zool. Soc. London, 1892, p. 389) and from Trujillo, November 23, 1912, Chubb, Ibis, 1919, p. 272). Two adults from "Lima," mentioned by Hellmayr and Conover (Cat. Birds Amer., pt. 1, no. 2, 1948, p. 231, footnote 1) were referred to *I. e. hesperis*, but are presumably *peruvianus*.

Taczanowski's record of "*Ardetta involucris*" from Pacasmayo (Ornith., Pérs., vol. 3, 1886, p. 399) probably also refers to *peruvianus*. *I. involucris* (Vieillot) is known to inhabit only the southern half of South America and the extreme northern portion of that continent, including Trinidad. Hellmayr and Conover (*op. cit.*, p. 230) suggest that northern individuals may be merely winter residents. However, Belcher and Smooker (Ibis, 1934, p. 582) have described eggs of *I. involucris* taken in Trinidad in July, August, and September. Mr. Smooker has shown me these, which are among the most remarkable and unmistakable of birds' eggs, for they are startlingly bright yellowish green, very different from those of *I. exilis*, a race of which, namely *I. e. erythromelas*, has also been found nesting in Trinidad (*loc. cit.*). Eggs of *I. involucris* had previously been collected in Argentina (Cat. Birds' Eggs Brit. Mus., vol. 2, 1902, p. 132; pl. 5, fig. 4). Apart from oölogical evidence that this species breeds in northern South America, I am able to record a female *I. involucris* in the Academy of Natural Sciences of Philadelphia that had enlarged ovaries when collected in the Caroni Swamp, Trinidad, on July 17, 1931.

It is noteworthy that, as a result of the description of *I. e. peruvianus*, there is no evidence of the occurrence of any North American race of the Least Bittern in South America, except from northern Colombia.

In pursuance of this study, I wish to express my appreciation to the curators at the American Museum of Natural History, U. S. National Museum, British Museum, and Paris Museum for permission to examine series of *I. exilis* in their charge.—JAMES BOND, Academy of Natural Sciences, Philadelphia, Pennsylvania.

**Philippine Bird Names of Blasius.** Seven bird names proposed by Blasius on April 15, 1890, and republished in August, 1890, are cited incorrectly by most authors with consequent confusion, with regard to certain names proposed by Steere in July, 1890.

The original paper of Blasius is not available to me and apparently has not been examined by any subsequent author, for I have not seen the page reference cited. Dr. G. Diesselhorst, of Munich, has kindly checked it for me in Braunschweig.

He writes me that Blasius read a paper on birds from Mindanao, in the March 13, 1890, meeting of the Verein für Naturwissenschaft and that this paper was reported in two parts in the Braunschweig daily newspaper, *Braunschweigische Anzeigen*, of 1890. The paper is an anonymous report on the meeting with the title, "Verein für Naturwissenschaft, 12. Sitzung am 27 März 1890." The first part of Blasius' paper appeared in *Braunschw. Anz.*, 27 Marz 1890 (No. 73), in which he said that all the birds treated were collected by Dr. Platen in Davao, Mindanao, and the second part in *Braunschw. Anz.*, 15 April 1890, No. 87, p. 877. Dr. Diesselhorst sent me a typed copy of this second part of the paper. In it seven species are described in full. In the *Journ. für Ornith.*, 38, heft II, No. 190, April [= August 1?], 1890, pp. 146-149, these descriptions were reprinted in full with the addition of measurements and the location of the types. It should be noted that there is a bibliographic error in this reprinted paper (p. 146) in which it is stated that it is reprinted from the *Braunschw. Anz.*, 15 April 1889. The year should be 1890.

In the same year, 1890, Steere published, "A list of the birds and mammals collected by the Steere Expedition to the Philippines . . ." pp. 1-30, Ann Arbor, Mich., July 14, 1890. In this, in ignorance of Blasius' paper, he described as new several of the species already named by Blasius. Unfortunately Blasius' names are often quoted from the *Journ. für Ornith.* for April = August, rather than the earlier *Braunschw. Anz.* for April 15, so that in some cases Steere's names have been given priority.

The allocation of Blasius' names and the relevant names of Steere follow:

(1) *Ptilocichla mindanensis* (Blasius)

This is the oldest name for the species that in recent years has passed as *Ptilopyga* (or *Ptilocichla*) *basilanica* Steere. The three subspecies are:

*Ptilocichla mindanensis mindanensis* (Blasius)

*Ptilopyga mindanensis* Blasius, *Braunschw. Anz.*, 15 April 1890, No. 87, p. 877 (type locality, Davao, Mindanao); *Journ. für Ornith.*, 38, Apr. [= Aug. ?], 1890, p. 146 (reprint). (The year is not 1888 as sometimes quoted.)

*Ptilocichla*(?) *Mindanensis* Steere, "List bds. mamms. Steere Exped." July, 1890, p. 18, no. 179 (type locality, Mindanao).

*Ptilocichla mindanensis basilanica* Steere

*Ptiocichla* [sic] (?) *Basilanica* Steere, "List bds. mamms. Steere Exped." July, 1890, p. 18, no. 178 (type locality, Basilan).

*Ptilocichla mindanensis minuta* Bourns and Worcester

*Ptilocichla minuta* Bourns and Worcester, *Minnesota Acad. Nat. Sci. Occ. Papers*, 1, p. 24 (1894) (type locality, Samar).

(2) *Stachyris plateni plateni* (Blasius)

*Mixornis Plateni* Blasius, *Braunschw. Anz.*, 15 April 1890, No. 87, p. 877 (type locality, Davao, Mindanao); *Journ. für Ornith.*, 38, Apr. [= Aug. ?], 1890, p. 147 (reprint).

(3) *Parus semilarvatus nehrkorni* (Blasius)

*Micropus nehrkorni* Blasius, *Braunsch. Anz.*, 15 April 1890, No. 87, p. 877 (type locality, Davao); *Journ. für Ornith.*, 38, Apr. [= Aug. ?], 1890, p. 147 (reprint).

(4) *Muscicapa (Ficedula) basilanica basilanica* Sharpe, 1877; has as a synonym:

*Muscicapula mindanensis* Blasius, *Braunsch. Anz.*, 15 April 1890, No. 87, p. 877 (type locality, Davao, Mindanao); *Journ. für Ornith.*, 38, Apr. [= Aug. ?], 1890, p. 147 (reprint).

(5) *Arachnothera clarae* Blasius

*Arachnothera clarae* Blasius, *Braunsch. Anz.*, April 15 1890, No. 87 p. 877, (type locality, Davao, Mindanao); *Journ. für Ornith.*, Apr. [= Aug. ?], 1890, p. 148 (reprint).

*Philemon Philippinus* Steere, "List bds. mamms. Steere Exped.", July, 1890, p. 21, no. 237 (type locality, Samar).

Sometimes *A. clarae* is credited to Platen, *Journ. für Ornith.*, 38, 1890, p. 148, which is Blasius' reprinted article of August, 1890.

(6) *Ceyx melanurus plateneae* Blasius

*Ceyx Plateneae* Blasius, *Braunsch. Anz.*, April 15, 1890, no. 87, p. 877 (type locality, Davao, Mindanao); *Journ. für Ornith.*, 38, Apr. [= Aug. ?], 1890, p. 148 (reprint).

*Ceyx Mindanensis* Steere, "List bds. mamms. Steere Exped.", July, 1890, p. 10, no. 66 (type locality, Mindanao).

*Ceyx Basilanica* Steere, "List bds. mamms. Steere Exped.", July, 1890, p. 10, No. 67 (type locality, Basilan).

(7) *Ceyx lepidus margarethae* Blasius

*Ceyx Margarethae* Blasius, *Braunsch. Anz.*, 15 April [not May], 1890, No. 87, p. 877 (type locality, Davao, Mindanao); *Journ. für Ornith.*, 38, Apr. [= Aug. ?] 1890, p. 141 (redescription, p. 148 (reprint).

*Ceyx Bournsii* Steere, "List bds. mamms. Steere Exped.", July, 1890, p. 10, no. 72 (type locality, Basilan).

*Ceyx Malamaui* Steere, "List bds. mamms. Steere Exped.", July, 1890, p. 11, no. 73 (type locality, Basilan).

*Ceyx suluensis* Blasius, *Journ. für Ornith.*, 38, April [= Aug. ?], 1890, p. 141 (type locality, Jolo, Sulu Islands).

*Ceyx suluensis* was not published in *Braunsch. Anz.*, May, 1890, No. 87, as sometimes cited.

A similar confusion has existed over five names proposed by Blasius in February and March issues of the *Braunschweigische Anzeigen* of 1888; later republished in *Ornis*, for 1888 (after April), and five for the same birds by Sharpe in the April 1888 *Ibis*. Blasius himself (*Ibis*, 1888, pp. 372-375) in a letter to the editor resolved this confusion. But this paper usually has been overlooked. It is not quoted in standard works on Philippine birds, and erroneous names were used for years. One still is being used. It is advisable to call attention to this paper again and to summarize the nomenclatural points from it:

*Strix selo-puto wiepkeni* (Blasius), 1 March 1888; takes precedence over *S. s. white-headi* (Sharpe), April, 1888.

*Muscicapa (Ficedula) plateneae* (Blasius), 1 March 1888; over *M. erithacus* (Sharpe), April 1888.

*Pachycephala plateni plateni* (Blasius), 1 March 1888; over *P. whiteheadi* (Sharpe), April 1888.

*Anasmos plateni plateni* (Blasius), 12 February 1888; over *A. johannae* (Sharpe), April 1888.

*Prioniturus discurus plateneae* Blasius, 12 February 1888; over *P. cyaneiceps* Sharpe, April 1888.—A. L. RAND, Chicago Natural History Museum, Chicago 5, Illinois.

**Is the Starling Moving into Southern Florida?**—The spread of *Sturnus vulgaris* in the United States has, of course, been widely commented on. Its rather recent appearance in the far western states of California and Oregon is known now to be apparently conclusive of further increase. The following comments concern one of the very few localities in the East which, hitherto, has seemed free of the species. This is southern Florida from about a line drawn from Tampa through Orlando to Titusville. Though having been established north of this line for years, any occurrence south of it, and particularly much south of it, was abnormal.

I have kept a close watch on this matter, for my work with the National Audubon Society has necessitated my presence in southern Florida through most of every winter, as well as other months, since 1936. I have been more particularly concerned with the regions known as the Kissimmee Prairie, the Everglades, and the Keys. The conduction of the Audubon Wildlife Tours, out of Okeechobee, began in 1940, and from early January to April each year, I am in the field four days each week in the prairie counties of Okeechobee, Highlands, Osceola, and Glades. One of the outstanding features of birdlife in this region has been the practically complete absence of the Starling.

In the very first season of these Tours (1940) and in highly unseasonal cold weather, a single Starling was noted near Brighton, Highlands County, near the Seminole Indian Reservation. This was in January of that year. Not another bird was seen in the entire area for the next thirteen years! On February 8, 1953, two Starlings were seen on telephone wires on the outskirts of Okeechobee, and on the tenth of that month, two more in another part of town, though these may possibly have been the same birds.

In the 1954 season, Starlings were more numerous in southern Florida. On January 22, 1954, a flock of between 25 and 30 birds was seen near Brighton (17 miles west of Okeechobee) by William Wylie, my assistant on the Audubon Tours. On February 11, 1954, four Starlings were seen at the southern city limits of Okeechobee, apparently investigating a cavity at the top of a dead Cabbage Palm (*Sabal palmetto*). They were watched by William Wylie, John Henry Dick, the writer, and his wife. On February 14, 1954, two small flocks were seen near the Indian Prairie Canal, Glades County, 17 miles SW of Okeechobee, by Louis A. Stimson of Miami.

While all of these observations surely indicate a penetration of unprecedented proportions, despite small numbers thus far, it does not cover extreme south Florida. Lake Okeechobee is, roughly, some two hundred miles north of Cape Sable. However, the Starling has now been observed as far south in Florida as it can possibly get, the Dry Tortugas! On November 21 and 22, 1952, one was watched by Douglas Ford and Lauri and John DeWeese, the latter Superintendent of the Fort Jefferson National Monument. The observation was made on Garden Key. In late October of 1953, another single Starling was watched "for several days" on Garden Key by the DeWeeses. Therefore this species has now been observed as far south in the United States as is possible and is moving into one of the last sections of the eastern part of the country.—ALEXANDER SPRUNT, JR., National Audubon Society, Charleston 50, S. C.

TREASURER'S REPORT, FISCAL YEAR  
ENDING SEPTEMBER 30, 1954

## INCOME TO ACTIVE FUND ACCOUNT

Dues	
Fellows.....	\$ 266.60
Members.....	780.00
Associates.....	9,876.17
	_____
Subscriptions.....	\$10,922.77
Sale of Back Issues of 'The Auk'.....	1,201.50
From authors for reprints.....	726.30
Miscellaneous sales.....	3.27
Royalty on Microfilms of 'The Auk'.....	106.07
Advertising.....	2.96
Donations to Active Publications Fund.....	151.50
Income from	
General Endowment Fund.....	390.00
Ruthven Deane Fund.....	1,932.43
	_____
Ruthven Deane Fund.....	367.47
	_____
<i>Total Income—1954.....</i>	<u>\$15,804.27</u>

## SPECIAL FUNDS

Brewster Memorial Fund	
Income from investments.....	\$ 594.62
Cost of 1953 medal.....	\$ 18.33
Honorary to Dr. Howard.....	576.29
	_____
	\$ 594.62 \$ <u>594.62</u>
Educational Endowment Fund	
Income from investments.....	\$ 109.63
Committee Expenses.....	\$ 3.36
To Active Account, 14 Student Members.....	56.00
Balance in Account.....	50.27
	_____
	\$ 109.63 \$ <u>109.63</u>
Bird Protection Endowment Fund	
Income (1953).....	\$ 75.45
Balance in Account.....	\$ 75.45
	_____
	\$ 75.45 \$ <u>75.45</u>
Endowment Fund	
Life Memberships.....	\$1,025.35
Donations.....	820.29
To Investing Trustees.....	\$ 1,180.00
Balance in Account.....	665.64
	_____
	\$1,845.64 \$ <u>1,845.64</u>

## Research Book Fund

Orders payed in advance.....	\$3,227.45
Less returned checks.....	\$ 24.00
Balance in Account.....	3,203.45
	<hr/>
	\$3,227.45 \$ 3,227.45

## Handbook of N. A. Birds Fund

Donation by R. G. Guernsey.....	\$ 500.00
Supplies and Equipment.....	\$ 266.25
Balance in Account.....	233.75
	<hr/>
	\$ 500.00 \$ 500.00

## Marcia B. Tucker Fund

Donation.....	\$ 250.00
To Robert Selander, 1954.....	\$ 250.00
	<hr/>
	\$ 250.00 \$ 250.00

## DISBURSEMENTS

Manufacture and Distribution of 'The Auk'.....	\$12,272.67
Reprints from 'The Auk' for A.O.U.....	130.84
Editor's Expenses.....	657.55
Secretary's Expenses (Wolfson).....	165.07
Secretary's Expenses (Mayfield).....	97.13
Treasurer's Expenses (Moser).....	16.54
Treasurer's Expenses (Sibley).....	663.54
Expenses 1952 meeting (printing of minutes).....	77.65
Expenses 1953 meeting, paid after meeting.....	513.33
Expenses 1954 meeting, paid before meeting.....	342.23
Zoological Record (refund).....	7.00
Addressing Service.....	508.96
Stationery.....	93.02
Purchase and postage on back issues of 'The Auk'.....	86.46
Mailing back issues of 'The Auk' from Lancaster.....	157.00
Bank charges and refunds (net).....	.85
Cost of Dues Notices.....	162.18
Research Committee Expenses.....	349.13
Membership Committee Expenses.....	65.00
Affiliation Fee, A.I.B.S.....	100.00
Canadian Committee (postage).....	2.53

## TOTAL EXPENDED—1954..... \$16,468.68

Total Income—1954.....	\$15,804.27
Expended over Income 1954.....	664.41
Balance in Active Account, 1953.....	667.35

Amount in Active Account.....	\$ 2.94
Balance in Endowment Fund.....	665.64
Balance of Educational Fund income.....	50.27

Balance of Bird Protection Fund income.....	75.45
Research Book Fund.....	3,203.45
Handbook Fund.....	233.75
	<hr/>
	\$4,231.50
Bank Balance September 30, 1954.....	\$ 4,325.38

CHARLES G. SIBLEY, *Treasurer*

STUDENT MEMBERSHIPS FOR 1955 SELECTED BY THE  
A.O.U. COMMITTEE ON STUDENT MEMBERSHIP AWARDS

Joseph Thexton Armstrong, Jr., Carleton College, Northfield, Minnesota  
Daniel Arthur Belkin, University of California at Los Angeles  
Willis John Bicket, University of Illinois College of Pharmacy, Chicago  
David A. Boag, University of Alberta, Edmonton, Canada  
Sylvia Alice Earle, Florida State University, Tallahassee  
Harry Richard Fevold, Montana State University, Missoula  
George Frederick Fisler, Michigan State College, East Lansing  
Thomas Robert Ford, College of Wooster, Wooster, Ohio  
Chandler Montgomery Fulton, Brown University, Providence, Rhode Island  
Kennedy Wenger Gilchrist, Evanston Township High School, Evanston, Illinois  
Jack Parker Hailman, Harvard University, Cambridge, Massachusetts  
Stephen Thomas Harty, Cleveland School of Art, Ohio  
Travis G. Haws, Brigham Young University, Provo, Utah  
Joseph Thomas Herberger, Colorado A. and M. College, Fort Collins  
John LaFollette Howland, Bowdoin College, Brunswick, Maine  
Raymond Roy Johnson, Arizona State College, Tempe  
John Henry Kaufmann, Cornell University, Ithaca, New York  
Mariette Anne LaBastille, Cornell University, Ithaca, New York  
Eugene Allen LeFebvre, University of Minnesota, Minneapolis, Minnesota  
Robert Earl Lemon, University of Western Ontario, London, Ontario, Canada  
Robert Douglas Lisk, Queen's University, Kingston, Ontario, Canada  
Barry Meadows, University of New Brunswick, Fredericton, N. B., Canada  
H. Gray Merriam, Ontario Agricultural College, Guelph, Ontario, Canada  
Ted Corneille Michaud, University of Michigan, Ann Arbor  
Miles Timothy Myres, University of British Columbia, Vancouver, B. C., Canada  
Arthur Leroy Nordby, Cornell University, Ithaca, New York  
Leon Brayton Polka, Harvard University, Cambridge, Massachusetts  
Thomas Laymon Poulson, Cornell University, Ithaca, New York  
William Glase Reeder, University of California at Los Angeles  
Stanwyn Gerald Shetler, Cornell University, Ithaca, New York  
Robert Irvin Smith, Utah State Agricultural College, Logan  
John Lester Stair, University of Arizona, Tucson  
Bette Ann Starner, University of Florida, Gainesville  
Stephen Neil Stephenson, Idaho State College, Pocatello, Idaho  
Thomas Michael Stockdale, Ohio State University, Columbus, Ohio  
James Garth Teer, University of Wisconsin, Madison  
Crystal Faye Wilson, University of Arizona, Tucson

## REVIEWS

**Bower-birds: Their Displays and Breeding Cycles.**—A. J. Marshall. (Oxford, The Clarendon Press). 208 pp., 26 plates with 64 illus., 2 general maps, 6 distributional maps. 1954. Price, \$4.80.—This work is primarily concerned with highly perplexing questions pertaining to the nature and function of bower-bird behavior—subjects which have long been confused by a preponderance of anthropomorphic fiction. The author's excellent studies of display, sexual cycles, and the evolution of bower making bring clarity to one of the strangest phenomena in nature. His report culminates some 20 years of work in field and laboratory (included is a bibliography of 290 titles). In the end, he comes to attach primary importance to the durability of behavior patterns and uses them as a key to ancient relationships. He demonstrates with clarity that all of the reasonably well-known genera of bower-birds have behavioral patterns which fall easily into three groups: 1) "stage-makers," 2) "avenue-builders," and 3) "maypole-builders." Types two and three he considers true bower-birds, but type one he suspects has arisen independently and is a result of convergent evolution. Therefore, he suggests the erection of a separate family, the *Ailuroedidae*, for *Scenopoeetes* and its non-stage-making relatives, the cat-birds.

The "recreational" theory of bower function and various suggestions that bower-birds are more "intelligent" than other birds are tested and refuted. Display and bower building are postulated to be primarily associated with reproduction. The bower, the focal point of unusually developed courtship behavior, is considered a manifestation of "displacement activity." Its purpose, the author believes, is to attract and hold the attention of the female and to assist in the synchronization of reproductive processes. No concrete evidence of polygamy in any of the species is reported, and the pair bond is found to be elaborate and enduring.

The most studied species is the Satin Bower-bird, which the author describes as building a bower which is ". . . a brilliant dash of colour on the otherwise sombre forest floor." Given are the scientific details of the ornamentation of this bower, which consists of bright parrot feathers, fresh flowers, fragments of colored glass and crockery. Nothing is overlooked, from vocal mimicry to sexual periodicity, pairing, bower orientation, use of tools in bower painting, nesting, and nomadic wanderings. The vast amount of field work forming the basis of this report is perhaps best reflected in the account of the marking of glass fragments with a diamond pencil, the distributing of them over an area of about 50 square miles, and the checking of the movements of the glass from bower to bower each week over a period of two years in order to discover how males pirated each other. Reported also are color preference tests given wild birds, and one extremely enlightening test given a bird raised in captivity which had never seen a decorated bower. These studies are deeply gauged: display, bower construction, "painting," color selection, and vocal mimicry all emerge as manifestations of innate behavior activated by the periodic influence of sex hormones.

An important portion of the book is devoted to internal rhythms and to a study of the basic events and stimuli which in ways still incompletely understood activate chains of reactions and patterns of remarkable complicity. The factors that play a part in regulating breeding seasons are discussed. Recapitulated are the epochal findings of Rowan and other methods by which birds are thought to keep in touch with seasonal changes to ensure optimum breeding conditions. Light *per se* is shown not to be the all-controlling factor, certainly not in equatorial latitudes and probably not elsewhere. A provocative suggestion is offered that perhaps, in company with the classical Sooty Tern, many equatorial birds will ultimately be found to have

breeding cycles which are not geared to the calendar. Rainfall is suggested as a most likely regulator because of its bearing on the abundance of food on which the young can best be raised.

This reader must confess to disappointment at the meagerness of data concerning molt and the tendency to oversimplification of molting seasons in species which dwell close to the equator. A minor defect is the map of New Guinea, which is not of recent vintage and was not prepared with the high degree of care lavished on the rest of the book. Misspellings of two prominent terrain features are unfortunate. A slip in the description of the *Cnemophilus*, described on page 144, should be noted. This very distinct race has the head golden yellow tinted with red on the forehead, not ". . . a clear red head." It is pertinent to mention also that, since Marshall's book went to press, the genus *Cnemophilus* has been removed from the bower-birds and put with the birds of paradise by Dr. Ernst Mayr (1954, Mayr and Gilliard, Birds of Central New Guinea, Bull. Amer. Mus. Nat. Hist., vol. 103, p. 362) on the basis of anatomical studies of birds collected in 1952.

The dearth of information pertaining to New Guinea bower-birds is emphasized and, it is hoped, will inspire local residents to take a hand in solving the many important riddles which so far have resisted detection and analysis. It is little short of fantastic that the bower of New Guinea's Regent Bower-bird (*Sericulus bakeri*), a species occurring in the neighborhood of populous Madang, should remain undiscovered. The bower of one of the two species comprising the genus *Archboldia* is completely unknown, as is that of the spectacular Golden Bird (*S. aureus*). Besides this, the mystery of the place of origin of *Amblyornis flavifrons* remains unsolved. The species is still known only from trade skins acquired during the era of plume collecting. These facts well illustrate that New Guinea, the home of most of the bower-birds (12 of the 18 species comprising the family occur in New Guinea, with only two of the New Guinea species occurring also in Australia) is still being surveyed for unknown species. Behavioral studies will follow later, perhaps much later in the case of species dwelling in inhospitable environs; that is, if the Australian Regent is a criterion. Indeed, it was something of a shock to learn how little is known of the display of this bird which lives in mountain forests within 60 miles of a city of one and a half million people. Vernacular names are always a source of difficulty. For example, recent evidence confirms Stresemann's decision to call *Archboldia sanfordi* a species (1954, Journ. für Ornith. 95, no. 3-4, p. 291) and not a race. Therefore, the "Golden-crested Black Bower-bird" so named by Marshall might best be renamed as follows: Sanford's Golden-crested Bower-bird for *Archboldia sanfordi* and Archbold's Bower-bird for *Archboldia papuensis*. The selection of the name "Gold-maned Gardener" for *Amblyornis flavifrons* seems inappropriate. Should not more be made of the fact that this golden-fronted species is the only crested gardener in which the forehead is not brown?

Marshall's suggestion that the stage-maker *Scenopoeetes* and the cat-birds be excluded from the *Ptilonorhynchidae* will probably not win acceptance. Indeed, after this book went to press Mayr (op. cit.) reported that his dissections showed *Ailuroedus* to be a typical bower-bird. Nevertheless, it is valuable to have these observations which use sexual display as the primary measuring stick.

Corroborative evidence in favor of part of the natural grouping advocated by Marshall is that provided by a study of their eggs. He points out that, although maypole-builders and avenue-builders do not exhibit plumage characters which render them readily divisible, their eggs (so far as known) are strikingly different. The eggs of the maypole group are plain and whitish, while those of the avenue-

builders are heavily marked. It is interesting to note that the eggs of the cat-birds (as well as *Scenopoeetes*) are unmarked.

This is a highly interesting, meritorious book.—E. THOMAS GILLIARD.

**A Guide to Bird Finding West of the Mississippi.**—Olin Sewall Pettingill, Jr. New York. Oxford University Press. 709 pp. 1953. \$6.00.—With the possible exception of Victor E. Shelford's *Naturalist's Guide to the Americas* this book and its companion volume on the eastern states are the only works of their kind. The scope of Pettingill's books is less comprehensive than Shelford's, but their treatment is more detailed.

The organization and style of this Guide are the same as those in its eastern counterpart. The introductory section of each chapter discusses the ornithology of the state as a whole, relating the distribution and migration of birds to physiographic regions, biological communities, and winter climate. These discussions are well written and can be of interest not only to those who are visiting a state for the first time, but also to those who are familiar with its opportunities for birding. For the traveler who must follow a route which does not include any of the places cited in the balance of each chapter, these introductions supply information on the types of habitats which are most profitably investigated and on the species of birds most likely to be found.

Thanks to the cooperation of the many people who provided Dr. Pettingill with information, the descriptions of specific places for finding birds are remarkably detailed. A lack of field work is indicated in those instances where details are sparse or misleading. Doubtless many of those who use this book will do so only in hopes of finding new birds to add to their life lists. But for more inquisitive and adventurous naturalists the book can also serve as a guide to little-known, though promising areas of biological interest.

Pen-and-ink drawings by George M. Sutton add greatly to the attractiveness of the book. His designs and clear handling of his medium enable him to convey impressions of light and depth with an economy of lines. The book closes with a useful list of suggested reference materials and an index.—PETER STETTENHEIM.

**The Yellow Wagtail.**—Stuart Smith. London. Collins. xiv + 178 pp., 8 figs., 8 plates. 1950. \$2.50.—This is the earliest of several New Naturalist Monographs that deal with birds. It concerns the Yellow Wagtail (*Motacilla flava*), its life-history and distribution. Knowledge of the European and particularly the British populations is stressed. Considerable detail on the distribution of these populations is given in an appendix. Another appendix deals with parasites. There is also, in the final chapters of the main text, a non-technical review of the nomenclatural history and geographic variation of this species.

This book is the product of a "continual hobby and sparetime preoccupation" by a "scientist whose normal work lies in a sphere far removed from ornithology." The text gives us many interesting and worthwhile facts concerning wagtails. Its main strength appears to lie in the descriptions of behavior and of the nesting cycle. The illustrations, in particular the paintings of Edward Bradbury, are excellent.—FRANK A. PITELKA.

## RECENT LITERATURE

EDITED BY FRANK McKINNEY

BAXTER, E. V. 1954. Some notes on the nesting of a Missel Thrush. *Scot. Nat.*, **66**: 49-50.

BLAIN, A. W. 1954. Bob-white [*Colinus virginianus*] eggs in pheasant [*Phasianus colchicus*] nest. *Wilson Bull.*, **66**: 217, 1 fig.

BOND, J. 1954. Birds of Turneffe and Northern Two Cays, British Honduras. *Notulae Naturae* (Acad. Nat. Sci. Phila.), **260**, 10 pp.—Annotated list.

BOND, J. 1954. A new race of *Gallinula chloropus* from Barbados. *Notulae Naturae* (Acad. Nat. Sci. Phila.), **264**, 2 pp.—*Gallinula chloropus barbadensis*, Graeme Hall Swamp, Barbados, B. W. I., new subspecies.

BOND, J. 1954. Notes on Peruvian Trochilidae. *Proc. Acad. Nat. Sci. Phila.*, **106**: 165-183.—Annotated list.

BORROR, D. J., and C. R. REESE. 1954. Analytical studies of Henslow's Sparrow song. *Wilson Bull.*, **66**: 243-252, 3 plates, 4 tables.—Songs of *Passerherbulus henslowii*, as analyzed by audio-spectrographs, are described in detail; they are far more complex than appears to the ear.—J. T. Tanner.

BOYD, J. M. 1954. The St. Kilda Wren in Village Area, Hirta, 1952. *Scot. Nat.*, **66**: 47-49.

BRODKORP, P. 1954. A chachalaca from the Miocene of Florida. *Wilson Bull.*, **66**: 180-183, 1 fig.—*Boreortalis laesslei*, new genus and species from lower Miocene deposits, Gilchrist Co., Florida.

CAMPBELL, J. L. 1954. Coot on Isle of Canna. *Scot. Nat.*, **66**: 42.

CAMPBELL, J. L. 1954. Barn Owl and Jackdaw in Isle of Canna. *Scot. Nat.*, **66**: 46-47.

CROSS, A. 1954. White-billed Diver [*Gavia adamsii*] in Angus. *Scot. Nat.*, **66**: 37-38.

GEORGE, C. J., and K. R. MENON. 1954. The physiological lag of the domestic fowl. *Journ. Animal Morph. Physiol.*, **1** (1): 77. Glucose and fat levels of blood correspond more closely to those found in lizards than in other birds. This physiological insufficiency plus organic deficiency of flight muscles are both responsible for lack of flight power.

GIBB, J. 1954. Feeding ecology of tits, with notes on Treecreeper [*Certhia familiaris*] and Goldcrest [*Regulus regulus*]. *Ibis*, **96**: 513-543.—Tits (*Parus major*, *P. caeruleus*, *P. ater*, *P. atricapillus*, *P. palustris*, and *Aegithalos caudatus*) often eat the same food but their seasonal preferences, foraging behavior, diversity of forage preferences, and singing and calling while foraging varies significantly from species to species. In winter when food is short the birds are more clearly different from each other in foraging ecology than at other times of the year. Proportionally more time is spent foraging in winter, although this varies with body weight, and the incidence of intra- and inter-specific conflict over food is higher. This work, part of a population study, is based on a single, standardized type of observation repeated some 12,000 times; the data are of high caliber and are not done justice by a short abstract.—R. F. Johnston.

GODFREY, W. E. 1952. Birds of the Lesser Slave Lake-Peace River Areas, Alberta. *Bull. No. 126, Ann. Rept. Natl. Mus. Canada*, 1950-1951: 142-175.—Annotated list of birds observed and collected.

GODFREY, W. E. 1953. Notes on Birds of the area of intergradation between eastern prairie and forest in Canada. *Bull. No. 128, Ann. Rept. Natl. Mus.*

Canada, 1951-1952: 1-52 (repaged reprint).—Annotated list of birds observed and collected in Manitoba.

GODFREY, W. E. 1954. Birds of Prince Edward Island. Bull. No. 132, Ann. Rept. Natl. Mus. Canada, 1952-1953: 155-213.—Annotated list in which are mentioned status, abundance, and specimens examined.

GRIERSON, J. 1954. Green Sandpiper at Morton Lochs, Fife, in February. Scot. Nat., **66**: 42-43.

GRIERSON, J. 1954. Roseate Tern nesting in Angus. Scot. Nat., **66**: 46.

HAFTORN, S. 1954. Contribution to the food biology of tits especially about storing of surplus food. Part I. The Crested Tit (*Parus c. cristatus* L.) Det Kgl Norske Videnskabers Selskabs Skrifter, 1953 (4):1-124. (In English.) Foraging behavior and food storage in coniferous forests in Norway were studied in three years during which food availability differed markedly. Storing of 642 items by *P. cristatus* is discussed; 80 per cent were vegetable, chiefly conifer seeds. Each of three species of titmouse which wintered in the conifers was found to hide food items (chiefly during summer) in the foraging sites used by that species in winter. Individual items probably are not remembered, a kind of hiding place being sought instead. Possibly the search may be concentrated in areas where storing activity of that individual was intense. Stored items usually are not visible from above; thus they may still be located when snow covers the branches. Attachment of stored items is partly by mechanical means, partly by organic substances (saliva of bird, body fluids of arthropod prey). Three-fourths of all stored items were concealed in contact with lichens. In severe winters, over one-half the diet of the Crested Tit consisted of stored vegetable food, an indication of the necessity of this behavior for survival.—K. L. Dixon.

HAVERSCHMIDT, F. 1954. Evening flights of the Southern Everglade Kite [*Rostromus s. sociabilis*] and the Blue and Yellow Macaw [*Ara ararauna*] in Surinam. Wilson Bull., **66**: 264-265.

HERROELEN, P. 1953. Inventaire des Oiseaux de la Tshuapa. Zooleo, no. 23, September, pp. 195-200.—The first part of a list of the birds recorded from the Tshuapa District, central Belgian Congo. This installment covers the grebes, cormorants, anhingas, herons, storks, hammerheads, ibises, and the ducks and geese, totalling 34 species in all.

HOFSLUND, P. B. 1954. The hawkpass at Duluth, Minnesota. Wilson Bull., **66**: 224.—A concentration point for thousands of migrating hawks.

HOWELL, J. C., A. R. LASKEY, and J. T. TANNER. 1954. Bird mortality at airport ceilometers. Wilson Bull., **66**: 207-215, 1 table.—Twelve instances of bird mortality at ceilometers are summarized together with the associated weather conditions, and the possible causes are discussed.—J. T. Tanner.

HOY, J. 1954. A phylloscopic warbler wintering in Fife. Scot. Nat., **66**: 52-53.

KAY, G. T. 1954. The Redwing [*Turdus musicus*] nests in Shetland. Scot. Nat., **66**: 50-52.

KERR, M. 1954. Sanderlings in South Inverness. Scot. Nat., **66**: 44.

KILHAM, L. 1954. Repeated territorial attacks of Pied-billed Grebe on Ring-necked Duck. Wilson Bull., **66**: 265-267.—Presumably because of the resemblances of a female *Aythya collaris* to a grebe, *Podilymbus podiceps*.—J. T. Tanner.

KNORR, O. A. 1954. The effect of radar on birds. Wilson Bull., **66**: 264.—When the beam of a radar was pointed at flocks of ducks, the birds' flight was greatly disorganized.—J. T. Tanner.

KORNFIELD, W., and A. V. NALBANDOV. 1954. Endocrine influences on the development of the rudimentary gonad of fowl. *Endocrin.*, 55 (6): 751-761. Small amounts of exogenous estrogen can suppress the development of the rudimentary right gonad of ovariectomized fowl. The demonstration of substantial quantities of estrogen in the blood of very young female chicks makes it probable that a hormone of this type is responsible for the failure of the development of the rudimentary gonad in the presence of the functional left ovary.

KURODA, N. 1953. On the skeletons of *Puffinus nativitatis* and *Pagodroma nivea*. *Tori*, 13 (63): 50-68.

KURODA, N. 1953. A note on *Sterna hirundo*: a genetic consideration about avian coloration. *Misc. Reports Yamashina's Inst. Ornith. Zool.*, 2: 74-77.—Hypothetical genetic mechanism to explain the geographic variation in color of the bill and feet. (In Japanese, with English summary.)

KURODA, N. 1954. On some osteological and anatomical characters of Japanese Alcidae (Aves). *Jap. Journ. Zool.*, 11: 311-327.—Comparison of the body skeletons of twelve species, with comments on the tongue and digestive tract. Correlations between structure and function are discussed.

KURODA, N. 1954. On the classification and phylogeny of the order tubinares, particularly the shearwaters (*Puffinus*), with special considerations on their osteology and habit differentiation. (Tokyo; published by the author) 179 pp., 38 pls., 5 maps.—The genus *Calonectris* is recognized for *Puffinus diomedea* and *P. leucomelas*, which are more highly specialized for flight and less specialized for swimming and diving than are the other shearwaters. A phylogenetic tree of the tubinares and a discussion of the spread of the group from its presumed place of origin in the North Atlantic are included.

LEACH, E. P. 1954. Montagu's Harrier nesting in South-West Scotland. *Scot. Nat.*, 66: 41-42.

LESTRADE, A. 1953. La Grue couronnée au Ruanda. *Zooleo*, no. 23, September, pp. 207-210.—An account of native legends and of the status of the Crowned Crane (*Balearica regulorum*) in Ruanda.

MACDONALD, D. 1954. Late migration of Pink-footed Geese. *Scot. Nat.*, 66: 40.

MACDONALD, D. 1954. Little Stints in South-east Sutherland. *Scot. Nat.*, 66: 43-44.

MACDONALD, D. 1954. Jay in South-east Sutherland. *Scot. Nat.*, 66: 47.

MACGREGOR, K. S., and F. D. HAMILTON. 1954. Temminck's Stint in East Lothian. *Scot. Nat.*, 66: 44.

MACKENZIE, J. M. D. 1954. Perthshire Pied Flycatchers, 1953. *Scot. Nat.*, 66: 54-55.

MCCLURE, H. E. 1954. Unusual migration of birds at Tokyo, Japan. *Wilson Bull.*, 66: 259-263, 3 tables.—Migrant species were more common during and after the arrival of a cold front.

MEIKLEJOHN, M. F. M., and A. G. S. BRYSON. 1954. The food of the Scarlet Grosbeak [*Carpodacus erythrinus*]. *Scot. Nat.*, 66: 55-56.

MEIKLEJOHN, M. F. M., and K. WILLIAMSON. 1954. Siberian Herring-Gull in East Lothian. *Scot. Nat.*, 66: 44-46.

MENON, K. R. 1954. The glucose and fat levels in the blood of five representative vertebrates. *Journ. Animal Morph. Physiol.*, 1 (1): 65-68. Pigeon (*Columba livia*) had more glucose and fat in the blood than a fish, a frog, a lizard, or a rat.

MENON, K. R. 1954. The oxyphoric capacity of the blood in five representative vertebrates. *Journ. Animal Morph. Physiol.*, 1 (1): 78-81. Number of corpuscles and iron content highest in blood of birds and mammals.

MILSTEIN, P. 1954. An egg problem. *Bokmakierie*, 6: 4-5.

MURPHY, R. C., R. J. NIEDRACH, and A. M. BAILEY. Canton Island. *Mus. Pictorial* (Denver Mus. Nat. Hist.) 10, 78 pp.—Fifty pages of this attractive publication are devoted to an annotated list of the birds of the island, one of the Phoenix Group. Many excellent photographs.

NAIR, K. K. 1954. A comparison of the muscles in the forearm of a flapping and a soaring bird. *Journ. Animal Morph. Physiol.*, 1 (1): 26-34. Certain wing muscles of a kite have two origins, or two bellies, or are split into two parts, whereas in the parakeet they have a single origin, one belly, or exist as a single muscle. It is concluded that with this doubling feature in the soaring bird, each part can act independently and alternately and thereby prevent fatigue.

NAIR, K. K. 1954. The bearing of the weight of the pectoral muscles on the flight of some common Indian birds. *Journ. Animal Morph. Physiol.*, 1 (1): 71-76. The weights of the pectoralis major and minor are compared to body weight and show very low values for the domestic chicken and duck (non-flyers), high for the pintail and pigeon (flapping flight) and next highest for the kite (soarer). Crow, parakeet, partridge, and house sparrow fall in between the kite and the non-flyers. Therefore soaring birds do not necessarily have low values nor is relation between muscle weight and wingspread always inverse.

PAYNTER, R. A., JR. 1954. Three new birds from the Yucatán Peninsula. *Postilla*, 18, 4 pp.—*Dendrocopides certhia legtersi* (Carrillo Puerto, Quintana Roo), *Platyrinchus mystaceus timothei* (24 km. NW. Xtocomo, Quintana Roo), and *Dumetella glabirostris cosumelana* (Isla Cozumel, Quintana Roo), new subspecies.

PORTER, R. D., and H. J. EGOSUCE. 1954. The Lark Bunting in Utah. *Wilson Bull.*, 66: 219-221.—Summarizing all records of *Calamospiza melanocorys* in Utah.

RAE, B. B. 1954. The Heron on St. Kilda. *Scot. Nat.*, 66: 39.

RAMSAV, A. O., and E. H. HESS. 1954. A laboratory approach to the study of imprinting. *Wilson Bull.*, 66: 196-206, 3 figs., 3 tables.—A series of experiments were performed with Mallard ducklings and with chicks to determine the optimum age for imprinting (13 to 16 hours) and to test other behavior related to imprinting.—J. T. Tanner.

RAND, A. L., and E. R. BLAKE. 1954. Birds the World Over as shown in Habitat Groups in Chicago Natural History Museum. *Chicago Nat. Hist. Mus.*, 96 pp., price, \$1.50.—A guide to the exhibits, illustrated with photographs of the habitat groups and sketches.

RAPP, W. F., JR. 1954. The status of cranes in Nebraska. *Wilson Bull.*, 66: 218-219.—*Grus americana* (extremely rare) and *G. canadensis* (great spring concentrations).

REED, E. K. 1952. General report on the archeology and history of Guam. U. S. Dept. Interior, Natl. Park Serv. (mimeographed.) 133 pp., 22 pls., 3 maps.—Contains short summary of the status of the various species of birds. (Out of print.)

RICHDALE, L. E. 1954. Duration of parental attentiveness in the Sooty Shearwater. *Ibis*, 96: 586-600.—*Puffinus griseus* is highly irregular in the timing of visits to its nestling young. Inattentive periods before the period of desertion range from 1 to 25 days ( $\bar{x} = 4.3$  days), attentive periods 1 to 11 ( $\bar{x} = 2.4$ ). Young remain in the burrows from 86 to 106 days. They leave, regardless of the degree of parental attention, apparently because of an internal urge. Following the regimen of parental duty, the adults desert the breeding area, apparently in response to an urge to migrate. This leaves numerous young still in burrows deserted for from 0 to 27 days ( $\bar{x} = 12$  days). Evidence indicates that young weighing more than

455 grams at desuetude can survive; those weighing less probably cannot. This is another excellent report of work done on Whero Island, New Zealand.—R. F. Johnston.

RICHTER, R. 1954. Eiders nesting in Banffshire. *Scot. Nat.*, **66**: 39-40.

RICHTER, R. 1954. Pied Flycatcher in Morayshire. *Scot. Nat.*, **66**: 55.

RIPLEY, S. D. 1954. Birds from Gough Island. *Postilla*, **19**, 6 pp.—Annotated list of 12 species. *Daption capensis*, *Fulmarus glacialisoides*, *Bulweria m. macroptera*, *B. incerta*, and *B. brevirostris* are recorded as new to the fauna. *Porphyriornis* is merged with *Gallinula*, and the Gough form (*comeri*) is considered a subspecies of *G. nesiotis* of Tristan da Cunha.

RIPLEY, S. D. 1954. Notes on Indian Birds. VI. Additional comments on the wren-babbler, *Spelaeornis*. *Postilla*, **20**, 4 pp.—*S. longicaudatus* and *S. chocolatinus* distinct species. *S. c. nagaensis* is a synonym of *S. c. chocolatinus*.

SANDEMAN, P. W. 1954. Snow Goose in Lanarkshire. *Scot. Nat.*, **66**: 40-41.

SCHÄFER, E., and W. H. PHELPS. 1954. Aves de Rancho Grande. *Bol. Soc. Venez. Cien. Nat.*, **16** (83): 3-167.—Annotated list of the rich avifauna of Rancho Grande (Henri Pittier National Park) in the Cordillera de la Costa of Venezuela between Maracay and the Caribbean. Ecological and altitudinal distribution, as well as notes on habits, are included.

SHELFORD, V. E. 1954. An experimental approach to the study of bird populations. *Wilson Bull.*, **66**: 253-258, 2 figs.—A few experiments, mostly concerned with the effect of ultra-violet radiation on reproduction of animals, are summarized, and suggestions are given for methods of studying environmental factors.—J. T. Tanner.

SKUTCH, A. 1954. Nest robber. *Nat. Hist.*, **63**: 306-309, 330.—Notes on the nesting habits of the Yellow-rumped Caciques (*Cacicus cela*) and a description of predation on its young by a snake (*Spilotes pullatus*).

SNOW, D. W. 1954. The habitats of Eurasian tits (*Parus* spp.). *Ibis*, **96**: 565-585.—This paper examines the habitats of and habitat selection in Eurasian and some Nearctic members of the genus *Parus*. Species near the same size live in different habitats or occupy distinct niches within a single habitat. Species differing in size may be found in the same habitat. Bill-shape varies with habitat, being longer and slenderer in coniferous forests, shorter and heavier in broad-leaved habitats.

STANFORD, J. K. 1954. A survey of the ornithology of northern Libya. *Ibis*, **96**: 449-473; 606-624.—A systematic list of the 194 species recorded for Cyrenaica. Taxonomic notes are included.

STEWART, P. A. 1954. The value of the Christmas bird counts. *Wilson Bull.*, **66**: 184-195.—Several suggestions are presented for standardizing the making and reporting of Christmas bird counts which should make the data more comparable and more easily analyzed.—J. T. Tanner.

STOKOE, R. 1954. Flocks of Black-throated Divers [*Colymbus arcticus*] in Wester Ross. *Scot. Nat.*, **66**: 37.

STRESEMANN, E. 1954. Ausgestorbene und Aussterbende Vogelarten, Vertreten im Zoologischen Museum zu Berlin. *Mitt. Zool. Mus. Berlin*, **30** (1): 38-53.—Extinct and nearly extinct bird species represented in the Zoological Museum in Berlin.

SUTTON, G. M. 1954. Blackish Crane-Hawk. *Wilson Bull.*, **66**: 236-242, 1 col. plate.—Description of the appearance and habits of *Geranospiza nigra* of Mexico and southward.

SUTTON, G. M., and D. F. PARMELEE. 1954. Nesting of the Snow Bunting or

Baffin Island. *Wilson Bull.*, **66**: 158-179, 2 figs., 1 table.—Results of a study of *Plectrophenax nivalis* thru one nesting season, from building thru fledging. There was remarkably high nesting success.—J. T. Tanner.

TEST, F. H., and E. R. VANDEGRIFT. 1954. Reactions of Chipping Sparrows to displaced nestlings. *Wilson Bull.*, **66**: 216-217.—The behavior of parent *Spizella passerina* after their nest had spilled 3 young onto the ground.—J. T. Tanner.

TRAILL-CLOUSTON, A. 1954. Black-necked Grebes [*Podiceps caspicus*] in Orkney. *Scot. Nat.*, **66**: 38-39.

VON MALTZAHN, H. 1954. A termite feast. *Bokmakierie*, **6**: 5.—Twelve species of birds recorded feeding on termites.

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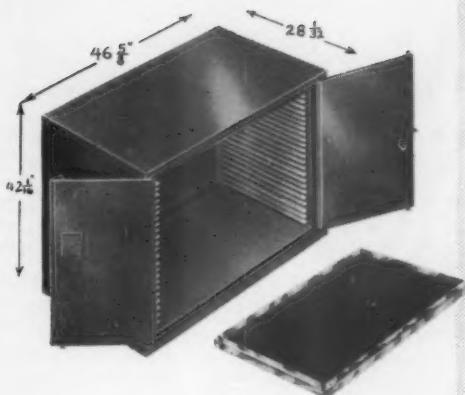
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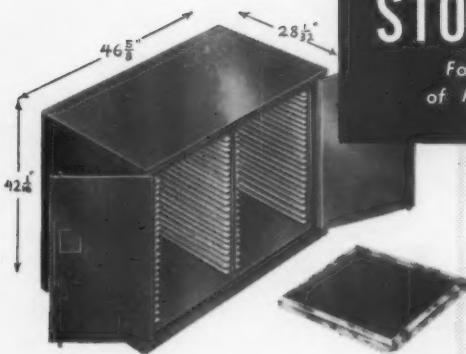
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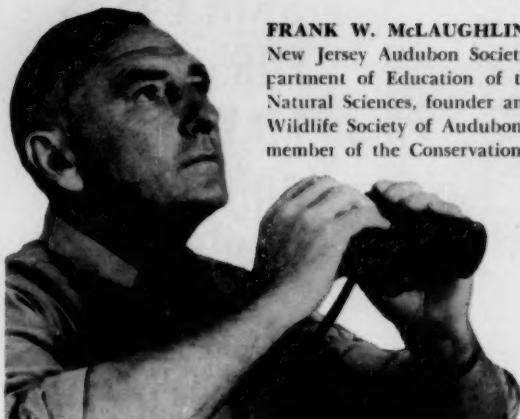
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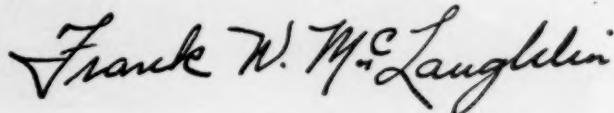


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